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ABSTRACT

This report examines how new information and communications technology may affect the economic system in which knowledge-based products and services are created, produced, packaged, distributed, delivered, and used. The following issues are considered: (1) the economic basis for the system of property rights in intellectual property, copyrights, patents, and trade secrets; (2) the economic behavior of producers of intellectual property; (3) the effects of the legal treatment of authors, publishers, packagers, distributors, and users; (4) the issues involved in estimating the harm to producers of intellectual property that results form the introduction of new technologies; and (5) the various types of government intervention that may be used to promote the supply of intellectual property. The text is supplemented by bibliographic notes and 61 references are provided. (Author/EW)

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A RAND NOTE

New Technologies and Intellectual Property: An Economic Analysis

Stanley M. Besen

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RAND

PREFACE

This Note was begun under a contract with the U.S. Congress Office of Technology Assessment as part of its study of "Intellectual Property Rights in an Age of Electronics and Information" and was completed under Grant No. IST-8415297 from the Division of Information Science and Technology of the National Science Foundation. Its purpose is to assist in developing a greater understanding of how new information and communications technologies may affect the economic system in which knowledge-based products and services are created, produced, packaged, distributed, and used. It examines (a) the economic basis for the systems of private property rights in intellectual property, copyrights, patents, and trade secrets; (b) the economic behavior of producers of intellectual property; (c) the effects of new technologies on that behavior; (d) the effects of the legal treatment of authors, publishers, packagers, distributors, and users; (e) the issues involved in estimating the harm to producers of intellectual property that results from the introduction of new technologies; and (f) various type of government intervention that may be used to promote the supply of intellectual property.

SUMMARY

The introduction of new technologies may have significant economic effects on the markets for intellectual property. Because intellectual property is a public good, the conditions required for its efficient supply are unlikely to be present in private markets. Achieving efficiency may require both that different prices be established for different consumers of the same intellectual property, and that exclusion of nonpaying consumers be easy. Neither condition is likely to be fulfilled. Moreover, production will occur in markets that are monopolistically competitive, where firms have market power because they provide differentiated products but entry of new producers is relatively easy. As a result, there may be either too much or too little "variety" in the intellectual property that is provided.

Because of the difficulties faced by producers of intellectual property in excluding nonpayers, its production is often supported by payments from advertisers or by "bundling" intellectual property with other (private) goods. Support from government and nonprofit sources also exists.

Advertiser support is likely where exclusion is difficult, or where there are legal restrictions on other methods of support, or where the intellectual property serves as a particularly effective advertising vehicle. Bundling is likely where there is a private good that is complementary to the intellectual property and where the producer of the intellectual property has an advantage in producing it. Direct sales to consumers, as opposed to bundling or the use of advertiser support, are more likely (i) the lower the price of the intellectual property, (ii) the higher the cost of forming a group to share it, (iii) the greater the ability of producers to raise prices when sharing occurs, (iv) the easier it is to exclude nonpayers, and (v) the more feasible is price discrimination among users.

The introduction of new technologies can significantly affect the behavior of producers of intellectual property. Technologies that permit copying can either benefit or harm producers and consumers

depending on, among other things, the costs of producing and distributing copies privately. New technologies, and the declining costs of telecommunications and computer storage, permit users to download entire databases to be searched later at their own convenience. Finally, computer software is increasingly being developed by firms that do not manufacture computer hardware, and by users themselves. In each case, producers can be expected to adapt to technological developments by changing the prices of their products, altering their product mix, adopting technologies that make copying or downloading more costly, or bringing legal actions against patent or copyright infringers.

The legal treatment of the various "stages" of the production of intellectual property, authorship, publishing, packaging, and distribution may also affect the efficiency of the production process. In the absence of legal restrictions, contractual relationships between authors and publishers, as well as those involving other participants, will be designed to achieve a division of the risk of success between the parties, to overcome asymmetries in information between authors and publishers, and to assure that each will expend his "best efforts." So long as the legal system permits the rearrangement of rights through contract and the costs of reassigning rights are not too great, regardless of how rights are initially assigned similar outcomes will be achieved.

Technological developments that permit derivative works to be more easily developed may present problems for producers of intellectual property. So long as all such works are produced within a single firm, or the production of derivative works can be detected easily, no special problem arises in their legal treatment. However, derivative works are increasingly being produced decentrally and in ways that cannot be detected. As a result, the legal rights of creators cannot easily be enforced. One possible effect is to increase the extent of vertical integration to make more difficult the development of derivative works by those other than the original creators.

There are a number of published estimates of the harm to producers of intellectual property resulting from unauthorized uses made possible by new technologies. The principal estimates are those prepared under the auspices of trade associations of producers of audio and visual

materials and computer software. Each of these groups claims substantial harm resulting from widespread unauthorized copying.

However, these estimates fail to analyze how the behavior of producers may change as a result of unauthorized copying. In particular, they do not estimate what prices would have been charged for originals if there had been no copying. The result is that the alternative situation against which current behavior is being compared is not carefully specified, and the resulting estimates may either overstate or understate the resulting harm. An alternative method for estimating harm, based on a model of consumer and producer behavior when a copying technology is introduced, may overcome this shortcoming.

Various methods are available to promote the supply of intellectual property. Defining private property rights and requiring rights holders to protect these rights through legal processes is a widely used alternative. Its principal limitations are that many kinds of infringements are not easily detected and that, because the harm from each individual infringement is often small, the use of collecting societies is frequently required.

A number of countries have imposed, or permitted to be imposed, levies on copying machines or media, to compensate rights holders for new types of infringements made possible by new technologies that are difficult to detect and prevent. The royalty fee may be set by the government, or by negotiations involving performing rights societies, or the government may permit private negotiations but reserve the right to limit the fee. Private establishment of fees may result in anticompetitive behavior and the government will not often possess the information needed to set fees appropriately.

Direct government assistance is often employed to support the production of intellectual property. However, in the absence of market signals, government may have considerable difficulty in determining whether to support particular types of production and the amount of support to provide. This means that government support should probably be confined to basic research where the extent of market failure is likely to be greatest.

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I. THE SIMPLE ECONOMICS OF INTELLECTUAL PROPERTY

Intellectual property is an archetype of the economist's public good. According to Samuelson (1954, p. 387), a public good has the attribute "that each individual's consumption of such a good leads to no subtraction from any other individual's consumption of that good...."[1]

Where the consumption of private goods requires as many units to be produced as are demanded by all consumers combined, the same amount of a public good that is produced is simultaneously available for consumption by all consumers. Thus, the use by one individual of a song, or computer program, or journal article, does not diminish the availability of that good for use by others. This characteristic of public goods is variously characterized as jointness, or nonrivalry, in consumption. A corollary of the fact that all consumers can use the same public good without diminishing the amount available for others is that the cost per user declines as the number of users increases.

Notice that we are distinguishing here between intellectual property, such as songs, computer programs, novels, or scientific articles, and their physical embodiment in, respectively, audio tapes or phonograph records, computer diskettes, books, or journals. Only the former are public goods, since they can be used by one person without reducing the quantity available for others. However, clearly, only one person can make use of a unit of the latter at any given time. Thus, the "cost function" for producing and distributing intellectual property is of the form $C = F + f(n)$, where F is the cost of producing the "first copy," or master, which is independent of the number of users, and $f(n)$ indicates that the cost of producing additional originals varies with the quantity that is produced. The jointness feature of intellectual property results from the fact that a portion of the costs, F, does not change as the number of users changes.

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[1]Actually, Samuelson uses the term "collective consumption good," but public good is the now commonly accepted terminology.

Public goods often, although not always, possess a second characteristic that distinguishes them from private goods. It is often difficult, or prohibitively expensive, to exclude those who do not pay to use public goods from the benefits that the goods provide to them. Thus, if a public good is national defense, or a fireworks display, it may be impossible to prevent "free riders," those who choose not to pay for access to the good, from benefitting from its existence. Indeed, if the public good is knowledge, the exclusion problem may be even more severe, since one may have to reveal to potential buyers the nature of the good to get them to purchase it. However, they may have no need to purchase it once it has been revealed to them.[2] This characteristic of public goods is often called nonexclusion.

EFFICIENT PRODUCTION WITH EXCLUSION

These two characteristics of public goods--jointness in consumption and the difficulty, or impossibility, of exclusion--make it unlikely that markets for public goods, such as intellectual property, will function as efficiently as do markets for private goods. The efficient production and distribution of private goods requires that they be produced to the point where the value that consumers place on the "last" unit equals the additional cost of producing it, its marginal cost. If private goods are produced in competitive markets, and if there are no externalities in their production, i.e., if producers bear all costs that result when the goods are produced and purchasers reap all of the benefits, the efficient amounts will be produced. Moreover, the prices of these goods will be equal to their marginal costs.[3]

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[2]Arrow (1962, p. 615) argues that "there is a fundamental paradox in the determination of demand for information; its value for the purchaser is not known until he has the information, but then he has in effect acquired it without cost."

[3]The allocation of resources is efficient when it is impossible to increase the value of the goods being produced by reallocating resources among them. The marginal cost of a good is the cost of acquiring the resources needed to produce an additional unit, which, in turn, equals the value of the outputs of other goods whose production must be concomitantly reduced. When the marginal value of a good equals its marginal cost, the efficient amount is being produced, since the value of additional output is less than the value of the associated reduction in the output of other goods. Similarly, if a smaller amount is

The condition required for the efficient production and distribution of public goods is much more complex and less likely to be fulfilled.[4] Essentially, efficiency requires that a public good be produced so long as the *combined* value placed on it by all consumers is equal to or greater than its cost. Each consumer can choose to consume different amounts of private goods, and thus can adjust his consumption so that the last unit purchased of each good is valued at its market price. In contrast, since the same public goods are potentially available to all consumers, the value that each consumer places on each unit produced will vary. Producing a good is efficient only if its combined value to all consumers at least equals the cost of producing it. The condition for efficient production that prevails for private goods, that the value of a good is equal to its marginal cost, is thus replaced for public goods by the condition that the sum of the values of a good for all consumers is at least equal to its marginal cost.[5]

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produced, the lost output will have a higher value than the increased production of other goods. Only where the value of output equals marginal cost is efficiency achieved.

Note that achieving economic efficiency is not necessarily synonymous with maximizing the returns to producers. In the calculus involved, the interests of both consumers and producers count. Indeed, the basis for promoting the interests of producers is that it is instrumental in promoting the interests of consumers.

[4]In some instances, public policy may be concerned with fostering objectives other than economic efficiency, e.g., by promoting the widespread availability of certain types of intellectual property. In such cases, the efficiency standard provides a benchmark against which to measure the costs of pursuing such policies.

[5]Generally, the value placed on a unit of a good by one consumer is assumed to be independent of the number of others who purchase it. However, the value of some goods may be affected by the number of other purchasers. Thus, for example, the value of subscribing to a telephone system increases the larger is the number of other subscribers, since this increases the number of others who can be called or from whom calls can be received. Similarly, the value of a computer may increase as the number of purchasers of compatible computers increases, since this may result in a greater variety of software from which to choose. The value of a particular print will be reduced as the number of other prints made from the same master is increased, if value inheres in possessing one of a small number that have been produced. And the value of certain types of information may be more valuable to any consumer the smaller is the number of other consumers with whom it is shared. For a sampling of the literature on interdependent demand see Leibenstein (1950); Rohlfs (1974); Katz and Shapiro (1985); and Farrell and Saloner (1985).

However, there may be goods for which there is no single price at which the producer can cover all of his costs but where total costs would be covered if consumers were charged different prices. Here, efficient production requires that a higher price be charged to at least some consumers who place a high value on the good.

Moreover, even if there exists a single price at which the costs of creating and distributing the good can be covered, the outcome may still be inefficient. Efficient distribution of a public good requires that it be made available to all consumers for whom its value at least equals the marginal cost of distribution. However, there may be consumers who place a value on the good that exceeds the marginal cost of serving them but is less than the price being charged. By charging these consumers a price that exceeds marginal cost but is less than the single price that covers costs, they can be made better off without making either the producer or other consumers worse off. As in the case where different prices must be charged to different consumers to achieve efficient production, here efficient distribution requires that more than one price be charged.

Although efficiency generally requires that producers of public goods set prices for different consumers to reflect differences in the value they place on the goods, producers are unlikely to have the information required to establish prices in this manner. And, of course, individual consumers will wish to misrepresent the value of public goods to them, to obtain lower prices.[6] If a uniform price is established for all consumers, the revenues of producers will be less than if consumers paid the value that they place on the last unit. As a result, it is unlikely that the efficient amounts of public goods will be produced.

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[6]Such a strategy is especially likely where the number of consumers is large, since any individual's contribution will not have a significant effect on the amount of the public good produced.

THE STRUCTURE OF MARKETS FOR INTELLECTUAL PROPERTY

If exclusion is possible, the private production of public goods, intellectual property for example, is possible, although, as we have argued, production will generally not be efficient. Where there are many producers of competing types of intellectual property, for example competing producers of phonograph records or word processing software, the resulting market structure is one of monopolistic competition.[7]

The industry producing the public good will be characterized by a number of firms, each of which has some control over the price it charges, and all of which earn only normal profits in the long run. Each firm has some control over its price, because the various public goods are somewhat differentiated. A firm can charge a price that exceeds that of its rivals without losing all of its customers because some consumers especially value the particular characteristics of its product.[8] In the long run, only normal profits are earned because supranormal profits attract entry by new firms, or the provision of new products by existing firms. This reduces the demand for existing products, and entry continues until only normal profits are earned by incumbent firms.[9]

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[7]See Chamberlin (1934).

[8]Of course, even they may shift their purchases if the price differential is large enough.

[9]In some markets for intellectual property, producers may continue to earn supranormal profits even in the long run. This occurs where barriers to entry prevent new producers from entering the market, attracting customers from incumbent firms, driving down prices, and eliminating excess returns. This situation probably characterizes the market for broadcast television, where Federal Communications Commission (FCC) restrictions have limited the number of stations that can be licensed in a community, although recent changes, e.g., the deregulation of cable television, probably have reduced the market power of broadcasters and their ability to earn supranormal profits in the long run. Individual newspaper markets are increasingly characterized by monopoly operations, which probably result from the existence of economies of scale, although the market power of newspapers and their ability to earn supranormal profits are constrained by the existence of limited circulation newspapers, national magazines, and radio and television stations. On concentration in broadcast television see Crandall (1978) and on concentration in newspapers see Rosse and Dertouzos (1978, pp. 72-81).

There are two important characteristics of the long-run equilibrium of such an industry. First, for the reasons discussed above, the equilibrium is unlikely to be efficient. Second, there may be either "too little" or "too much" variety in the products that are offered. Excessive variety may result because, although firms will find entry profitable if they can attract enough consumers from other producers to cover their costs, since the products are public goods, the reduction in the number of consumers served by existing firms does not produce a commensurate reduction in their costs. Entry may, thus, prove to be profitable even if the cost incurred by the entrant exceeds the value that consumers place on the additional variety.[10]

It is also possible, however, that the equilibrium will be characterized by too little product variety. This will occur if firms find it more profitable to "duplicate" the products of their rivals rather than offer differentiated products. If the profitable provision of highly differentiated products can occur only where different prices can be charged to different consumers of the same product, whereas undifferentiated products can be sold profitably at a single price, the differentiated products will not be offered even if efficiency would be increased by doing so.[11]

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[10]The inability to charge different prices to different consumers produces this result. If defecting consumers could be offered a lower price to encourage them not to choose the new product, other consumers might be better off, even if they must pay a higher price than the would-be defectors.

[11]For two analyses of the provision of public goods in competitive markets see Demsetz (1970) and Oakland (1974). In both models, the products sold by competing firms are perfect substitutes. In the Demsetz model, the production of public goods by competitive firms is efficient, because Demsetz assumes that different consumers of the same good can be charged different prices. Production is inefficient in the Oakland model where the same price is charged to all purchasers from the same firm.

THE EFFECT OF NONEXCLUSION

The problem caused by the inability of producers to charge different prices to different consumers is exacerbated when it is impossible, or prohibitively expensive, to exclude nonpayers. Where exclusion is not possible, individual consumers can rationally be expected not to make payments for the use of the public good, since they have access to the good whether they pay for it or not.[12]

In the case of intellectual property, the patent and copyright systems are designed to deny to those who do not make payments the use of the fruits of intellectual effort. However, even when intellectual property is protected in this way, exclusion may still be difficult. For example, preventing private copying is likely to be difficult, even if the law grants creators the right to control such uses.

If owners of intellectual property are unable to exclude nonpayers, their revenues will decline and their willingness and ability to produce new types of intellectual property will diminish.[13] What the effect of this reduction will be on the efficiency of the supply of intellectual property is a difficult question that depends, in turn, on the answers to two other questions: First, by how much will the supply of intellectual effort be reduced when the return to such effort is reduced? What, in other words, is the elasticity of supply of intellectual property? Second, given any reduction in the amount of intellectual property produced, what effect will there be on economic efficiency?

THE ELASTICITY OF SUPPLY OF INTELLECTUAL PROPERTY

Assessing the elasticity of supply of intellectual property is a difficult, if not impossible, undertaking. The basic reason for this lies in the differentiated nature of the products involved. If we were trying to estimate the elasticity of supply of a standardized product,

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[12]Once again, the validity of this statement is enhanced if the number of consumers is large.

[13]The next section deals with methods of finance that suppliers of intellectual property may adopt as alternatives to direct sales to consumers.

say West Texas intermediate crude oil, we could gather market data on its price, the quantity exchanged during any period, and the variety of factors thought to influence the supply and demand for oil. With this information, estimating the demand and supply functions is a feasible undertaking.[14] Given the supply function, one can estimate the effect of a reduction in the amount that consumers will pay for oil on the amount that is offered on the market and on its price.

Where the good in question is not homogeneous, however, it is far more difficult to estimate the supply function, since a change in the amount paid to producers will affect both the *quantity* and *nature* of what is produced. As a result, determining the effect of a shift in demand on the quantity supplied and its price is a difficult undertaking. Thus, for example, unless one is prepared to treat all word processing programs as perfect substitutes, one cannot easily characterize the effect of a reduction in the return to software suppliers on the amount of such programs that are produced and sold.[15]

There may be no change in the number of programs available, but a reduction in the quality of each. Or, the number of programs may decline, with the smaller number being worse than, as good as, or even better than the larger number that they replace.[16] Or, there may even be an increase in the number being offered, with each being of lower quality than the larger number originally offered.

To determine the effect on supply of a change in the rewards to producers, one begins by obtaining data on the number of units of a given type of product, say, word processors, that were sold in various periods, as well as on the prices paid to suppliers in those periods.[17] Since output is not homogeneous, one must adjust the data to control for

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[14]See Klein (1962, pp. 8-19) for an elementary exposition. For a more advanced treatment see Kmenta (1971, pp. 539-550). Even where the product in question is homogeneous, estimation of the supply function may be a formidable task.

[15]We are assuming that exclusion is not so difficult as to prevent production entirely. If the costs of exclusion are independent of the number of customers, only firms with a large customer base may find it profitable to incur such costs.

[16]The smaller number may or may not be among the larger.

[17]These data often are not publicly available.

differences in "quality." Doing so permits both the aggregation of information about different products sold during the same period as well as comparisons among the amounts of all products that are sold during different periods.

If one knows the values that consumers place on the different characteristics of, say, word processors, e.g., speed, ease of use, and capacity, in principle the necessary quality adjustment can be made. First, the prices of the various packages in some base period are statistically related to their characteristics to determine the values placed by consumers on each of the various attributes.[18] These values, and the characteristics of each package sold in each period, are then used to weight the output of each package in each period and the quantities of each package sold, adjusted for "quality," are added together for each period. The resulting totals reflect changes over time in both the number of packages sold and their characteristics. If improvements in quality occur, the quantities are adjusted upward to reflect that fact. Thus, a twofold improvement in each characteristic results in a doubling of measured output, if there is no change in the number of packages sold. Finally, the market "price" is obtained by dividing total revenues from the sale of all packages by quality-adjusted output.

Adjusting quantity data to account for differences in quality may be a feasible undertaking where the characteristics of a good are easily identifiable and are changing slowly.[19] Where changes are rapid, so that new characteristics are continually being made available and are occurring in combinations previously uncontemplated, the task is a formidable one, indeed. To carry out the quality adjustment, it is necessary to place a value on each of the characteristics. But how, for example, is one to determine, using price data from an earlier period, the value that consumers place on having a word processor, a spread sheet, and a database manager combined in the same software package? In

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[18]Griliches (1961) carries out such an analysis for automobiles. For similar analyses of the prices of computer hardware see Fisher, McGowan, and Greenwood (1983, pp. 139-163), Cartwright (1986), and Cole et al. (1986).

[19]Even there, however, it is likely to be difficult.

addition, one has the problem of determining how to define the class of products being considered. Should it, for example, be all applications programs or should there be separate analyses for spread sheets, word processors, and database managers?

Constructing a consistent set of data on quality-adjusted output and price is, of course, only the first step in the process of estimating the elasticity of supply. The analysis also requires the ability to control for factors other than price that affect supply. That is, changes in prices and their associated changes in output suffice to identify the supply curve only if it can be assumed that the function relating quantity supplied to price is unchanging. If, however, there are factors other than price that affect supply, these must be taken into account. Thus, for example, advances in microelectronics may affect the cost of providing a given capability in a computer program, which, in turn, will affect the supply of (quality-adjusted) output. Clearly, where technology is changing rapidly, it will be difficult to control for the effects of these other factors.

As we have already argued, even where exclusion is possible, there may be too much variety in the range of intellectual property produced. One implication of this result is that, even if the inability to exclude nonpayers *reduces* the *amount* of intellectual property supplied, the result may be to *increase* the *efficiency* of supply, by bringing variety closer to the optimum. Instead of a relatively large variety of imperfect substitutes being produced, each at a relatively high cost (and price) per user, the reduction in the returns to producers may result in fewer producers each serving a larger number of consumers, at a lower cost per consumer.[20] The result is that consumers may actually be better off.

Of course, the reduction in the returns to producers that results from their inability to exclude nonpayers may make consumers worse off. This occurs if the additional variety that is lost when some producers leave the industry is valued by consumers at more than its additional cost. As we have already seen, there will be circumstances in which

[20] In both situations, of course, the firms that survive earn only normal returns. This results from the assumption that there is free entry.

consumers may prefer a wide variety of products, although each must be produced at a higher cost per user than if a narrower variety were available. In such circumstances, if nonpayers cannot be excluded, the result is to reduce the efficiency of supply.

BALANCING EFFICIENT SUPPLY AGAINST EFFICIENT USE

The contention that an increase in the return to producers of intellectual property will necessarily lead to an increase in the the efficiency of its supply has also been challenged on other grounds. In two articles highly critical of the copyright and patent systems, Plant (1934a, 1934b) argues that patent and copyright protection may actually reduce economic efficiency. Plant contends that the existence of private property rights in intellectual property may have only a limited effect in encouraging the *creation* of new ideas and that, by limiting the competition to which producers are subject, it raises the prices of goods embodying intellectual property, leading to the inefficient *use* of such ideas. He argues that unless the gains from additional creation more than offset the inefficiencies from reduced use, the copyright and patent systems cannot be justified. As Plant puts it: "The only conceivable line for such an argument to take would seem to be that ultimately the inventions of a patentable type which will be made in response to the grant of a temporary monopoly will possess a sufficiently greater usefulness than would result from the other inventions or other output immediately foregone, to outweigh the immediate loss. There surely exists no scientific reason for making any such claim for patentable inventions in general, as compared with alternative output" (Plant 1934b, pp. 42-43).

Of course, for copyrighted material to be published, the publisher must be able to obtain revenues at least equal to the cost of producing the "first copy," as well as the cost of additional copies that are produced. Thus, even if a manuscript is provided without cost to the publisher, say because the author has nonpecuniary objectives in getting it published, the publisher must incur the costs of editing, typesetting, proofreading, etc., as well as the costs of printing. The question then arises as to how, in the absence of copyright protection, revenues sufficient to cover these costs will be obtained, since

presumably a second publisher could avoid many of the costs incurred by the first publisher. Nonetheless, Plant argues that publication would occur, and that it did occur in nineteenth century America, even in the absence of copyright protection.

Breyer (1970) argues that the first publisher has a number of advantages that inhere in being first that make profitable publication possible even in the absence of copyright. First, he argues that the initial publisher's book will reach the market first, thus creating a marketing advantage over publishers who enter the market later. Presumably, the argument is that the first publisher will be able to make sales during the period before he must face competition from a second publisher's book. Since consumers can be expected to anticipate the second publisher's entry into the market, the advantage that results from entering first is primarily the result of the fact that some consumers value early access.

Second, Breyer argues, following Plant, that a second entrant may be discouraged by the fear that, if he enters, the initial publisher will reduce price below the cost of the entrant, thus rendering entry unprofitable. Whether this will be a rational strategy for the incumbent firm to pursue, and how it might go about pursuing it, can be assessed in the context of the modern literature on "strategic entry deterrence."[21] A first entrant, fearing the possible arrival of a second firm, can arrange to print more copies than he anticipates selling at the price he plans to establish. Although this involves incurring additional costs, the presence of these additional copies serves to discourage the second entrant if a rational, i.e., profit maximizing, response to entry is to place the additional books on the market.[22] If the strategy is rational, and if the second entrant recognizes it as such, entry may be discouraged, since placing the

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[21]See Salop (1979) for a brief introduction.

[22]An essential element of an entry deterring strategy is that the incumbent commits himself to an irreversible investment. The printing of the additional copies is such an investment. Merely threatening to reduce price, or to print additional copies, if entry occurs may not be an effective strategy if the potential entrant realizes that pursuing the strategy is not profitable for the incumbent.

additional supply on the market will reduce the market price. The additional copies play the same role as does the excess productive capacity analyzed by Spence (1977).

It should be noted that although this approach may permit the first publisher to operate profitably, it still permits the exercise of market power. Indeed, since real resources must be expended to print the "excess" copies, the outcome may be less efficient that if a copyright were granted in the first place.[23] Breyer appears to approve the adoption of strategies by the first entrant to discourage entry, and thus create market power, yet he rejects copyright because it leads to market power.

Third, Breyer argues that the initial publisher may be able to operate profitably if he can obtain a large number of orders in advance of publication. Although this is surely correct, the question arises as to why customers will wish to place such orders if they anticipate that lower cost copies will be on the market shortly after the initial publication. Any individual customer has an incentive to "free ride" on the behavior of others by not placing an early order. But if all customers attempt to free ride, this strategy will not be successful.[24]

What the Plant-Breyer arguments come down to is a belief that the balance between encouraging creative effort and promoting widespread distribution of intellectual property may be struck more efficiently for some types of goods without a copyright system. They believe that, although encouraging the creation of intellectual property may require that publishers have some market power, the extent of market power created by copyright may, at times, be excessive. In those cases, they argue, allowing publishers to obtain market power through their own efforts may result in a more efficient allocation of resources than that produced under the copyright system.[25]

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[23]This is because the copyright deters entry but does not consume resources as does the "excess production" strategy. There are, of course, costs involved in obtaining and enforcing the copyright.

[24]Of course, the initial publisher can offer to sell at a low price to those customers who commit to early purchases, but then the return to publishing is reduced, and some books may not be published. For analyses of the problem faced by a firm that attempts to charge a higher price to "early" purchasers than to later ones see Coase (1972) and Bulow (1982).

[25]The argument seems not to have been characterized in this way, but this interpretation is consistent with Plant's contention that, in

The appropriate legal treatment of intellectual property for promoting economic efficiency is almost certainly somewhere between the Plant-Breyer view that no protection is needed, and the other extreme in which all rights in property should be granted to creators for all time. The question is, thus, not whether to grant patent or copyright protection, but rather what is the appropriate period of protection and what rights should be covered.[26] The "correct" answer is likely to differ among types of intellectual property.

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nineteenth century America, "competition remained sufficiently removed from that abstract condition of 'perfection,' in which there could exist no margin between receipts and costs for the remuneration of authors, for 'handsome sums' in fact to be paid." Plant (1934a, pp. 172-173).

[26]For an interesting attempt to determine the "optimal" life of a patent see Nordhaus (1969, pp. 76-86).

II. ECONOMIC BEHAVIOR OF PRODUCERS OF INTELLECTUAL PROPERTY

The special characteristics of intellectual property--jointness in consumption and the difficulty of exclusion--have resulted in the adoption by producers of a variety of ways of marketing their products. Producers do not confine themselves to selling individual units of their products directly to final consumers. Instead, they may employ advertiser support, or they may attempt to bundle the intellectual property with private goods to enhance their ability to exclude nonpayers. In addition, it is common for producers to attempt to exploit their products over extended periods of time and in different markets. Finally, a substantial portion of the supply of intellectual property is supported by grants from governments or nonprofit institutions. This section discusses the factors that affect the choice of marketing approaches that producers must make.

ADVERTISER SUPPORT

In principle, even the production of private goods could be supported through the sale of advertising. A pair of shoes, for example, could be packaged together with advertising material, with the advertiser paying all or a part of the cost of making the shoes in return for the opportunity to have his advertising reach the shoe buyer. If this method of support were employed, the price of shoes would be lower than if consumers were required to pay for them. Moreover, those types of shoes would be produced that advertisers found most effective in reaching consumers.

Of course, advertiser support for the production of private goods is rare, or nonexistent. Rather, advertiser support seems confined entirely to a class of public goods--printed matter and audiovisual material--and not even to all members of this class. For example, although newspapers and mass audience magazines are supported in large measure by advertising (with substantial support directly from subscribers in some cases),[1] publications such as professional journals

[1]Advertising revenues constitute about three-quarters of the

are supported almost entirely from subscription revenues. And, although advertising now constitutes a large portion of the support for certain types of entertainment programming on television--series and sports--motion picture production is supported in large measure by direct sales to moviegoers.[2] "Made-for-television" motion pictures are an obvious exception.

There appear to be three principal bases for determining which types of intellectual property are supported by advertising. First, the fact that radio and television have traditionally been supported in this way probably results from the fact that, until recently, no other method of finance was feasible. Early radio stations did not possess the technical means to exclude nonpaying listeners. An enterprising station owner decided to experiment with advertising to see whether revenues might be generated in this manner. The result was far more successful than anyone had anticipated, and advertising remains today the principal basis on which commercial radio and television stations are supported. Where exclusion of nonpayers is a problem, advertising may be an effective alternative means of support.[3]

More recently, however, technological developments have permitted television programs to be made available only to viewers who subscribe to a particular service. Almost all subscription services to viewers in their homes provide all of the programming on a particular channel in return for a monthly fee.[4] On rare occasions, subscription programming is provided per program, but the cost of excluding nonpayers still is

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revenues of newspapers. Among magazines, they represent about 80 percent of the revenues of farm periodicals, about 70 percent of the revenues of business and professional periodicals, and less than half of the revenues of general periodicals. See Sterling and Haight (1978, p. 158, p. 174).

[2]The sale of motion pictures to advertiser-supported television was a more important source of support before the widespread availability of pay television over cable. Motion picture studios today delay the sale of films to advertiser-supported television until the end of the pay "window." As a result, both the networks and individual broadcast stations are willing to pay less for such films, because many viewers will already have seen them on cable.

[3]Since exclusion is generally not a problem for private goods, we generally do not observe their production supported in this way.

[4]For descriptions of the various industries now supplying pay television services see Braunstein (1980) and Glen (1980a, 1980b). Pay-per-view is still largely limited to hotel viewing.

sufficiently great that only when the fees that can be collected for an individual program are very high can these exclusion costs be justified. In the future, it is reasonable to expect that pay-per-view will become more widespread, as technological change reduces the costs of exclusion.[5] As a result, advertiser support is likely to become proportionally less important for the support of television.

Advertiser support has also been employed when there were restrictions on other means of support. When pay television was first proposed in the 1960s, in response to complaints from theater owners and broadcasters, the Federal Communications Commission erected a series of barriers to the provision of pay television that effectively stifled the industry until the Home Box Office decision in 1977.[6] Restrictions were placed on the amount and nature of the programming that could be provided,[7] on the portion of the program schedule that could be devoted to pay television transmissions, and on the licensing of stations to provide pay programming.[8] These rules are now all abolished, but when they were in effect they significantly constrained the ability of producers of certain types of intellectual property to use means of financing other than advertising. For example, a rule that prevented television series programming from being carried on a pay basis meant that such programming had to be supported by advertising, if it was to be provided at all.

Finally, advertisers can be expected to employ those media that are most effective in promoting their wares. Thus, for example, newspapers can obtain revenues from subscriber sales and have never been restricted from doing so, yet, because they are an effective advertising medium, they continue to rely heavily on advertiser support. The same is true

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[5] See "Pay-Per-View TV Is Gaining Subscribers As Fixed-Schedule Cable Loses Favor," *Wall Street Journal*, January 10, 1985, p. 29, for a discussion of these developments.

[6] *Home Box Office, Inc. v. FCC*, 567 F.2d 9 (1977); Cert. den. 434 U.S. 829 (1978).

[7] 15 FCC 2d 466 (1968); 34 FCC 2d 271 (1972); 52 FCC 2d 1 (1975).

[8] The "complement of four" rule, which prevented the licensing of a pay television station unless there were at least four advertiser-supported stations in a market, was repealed in 90 FCC 2d 341(1982).

for certain types of magazines. So long as advertisers need to advertise, they can be expected to support those creative activities that assist them in doing so.[9]

Many of the media that are effective as advertising vehicles--radio, television, newspapers, and magazines--seem to have a common characteristic. All of them appear frequently, some more or less continuously, others daily or weekly. Thus, advertising of new products, or new prices for old products, or the repetitive advertising of products is possible using these media. These same ends cannot be accomplished through those media that appear less frequently.[10] If the same newspaper could be employed over and over again it would not be such an attractive vehicle for certain types of advertisers. For the same reason, we would not expect computer programs to be supported by advertising, since consumers are likely to use the same program many times over a long period of time. Nor would we expect prerecorded audio or video records or tapes to be employed in this manner. However, if these products are rented for a single use, rather than purchased to be used many times, advertising might be feasible as a means of support.[11]

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[9]In principle, advertisers could limit themselves to "advertising-only" vehicles, e.g., billboards and fliers. However, the long history of support for magazines and newspapers in the absence of any legal restriction suggests that this is unlikely to occur. Moreover, even in the absence of legal restrictions on the provision of programs on a subscription basis, television is likely to continue to be a major recipient of advertising revenues.

[10]Other media may, however, also have unique advantages for certain types of advertising. The ubiquitous nature of telephone directories makes Yellow Page advertising desirable, even though these publications are updated only once a year. In the future, "electronic Yellow Pages" may permit this medium to compete even more effectively with newspapers for certain types of advertising. For this reason, newspaper publishers have sought to limit the ability of telephone companies to provide this service. However, it could be provided by lessees of telephone facilities, including the newspapers themselves. For a discussion of the economics of electronic Yellow Pages, see Pool (1983, pp. 206-209).

[11]If videogames were downloaded to personal computers only as used, advertising might be a feasible source of support, especially if it is easy to change advertising messages.

"BUNDLING" WITH PRIVATE GOODS

One way in which producers of intellectual property can be expected to attempt to overcome the exclusion or "free rider" problem is by combining the sale of the public good with the sale of a private good for which exclusion is feasible.[12] A modern example involves the provision of user services of computer programs only to authorized purchasers. If these services are especially valuable, and if possessors of unauthorized copies cannot obtain them, consumers can be expected to purchase originals directly from the producer even if copying were easy and undetectable. Another example is the provision of detailed program guides by some public television stations to encourage contributions by viewers who cannot be excluded even if they do not pay.

Under the bundling strategy, the firm sells the bundle at a price that exceeds the cost of producing the private good. The difference is used to support the production of the public good. Thus, the success of the strategy hinges on the ability to price the bundle at a level that generates sufficient revenues to support the production of both goods.

The feasibility of bundling public with private goods to encourage the provision of the former will, of course, vary among products. For the strategy to be successful, the firm providing the public good must have an advantage in providing the bundled private good. If the private good can be provided as efficiently by firms other than the provider of the public good, consumers can be expected to avoid purchasing the bundle, and the strategy will be defeated.[13] If a rival program guide can be produced at the same cost as can the one provided by the television station, it will garner the entire market if the station attempts to charge more than the cost of its production.

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[12]For a general discussion of this approach see Olson (1968). Olson argues that, in the absence of coercion to join a group that provides a public good, an individual will join only if "he has to support this group in order to obtain some other noncollective benefit." He calls this the "by-product" theory (Olson, 1968, p. 134).

[13]The economics are similar to those involved in the controversy over resale price maintenance. Full service stores may have difficulty surviving if they incur the cost of providing information, a public good, to shoppers who, in turn, purchase the good at a lower price from discounters, who do not provide information. See Overstreet (1983, pp. 45-62) for a discussion of this issue.

There must, of course, be some complementarity between the elements of the bundle for consumers. Otherwise, a producer with a cost advantage in producing the private good would earn larger profits he chose *not* to provide the public good. However, if the private good has value only if the public good is also provided, the firm will be forced to offer both.[14] The seller would have no objection, however, to offering the private good to those who do not wish to consume the public good. Thus, collectors of program guides would not be prevented from purchasing them, even if they never watched the station.

DIRECT SALES TO CONSUMERS

Despite the difficulties of excluding nonpayers and of charging different prices for the same public good to different consumers, the production of many public goods, including intellectual property, is financed largely, or entirely, through direct sales to consumers. Thus, recorded songs, computer programs, and professional journals are sold directly to consumers, unbundled with any other products.[15] Or, in other words, although excluding nonpayers is difficult, there are instances in which individual consumers prefer to purchase their own unit of the good rather than to share with other consumers. And, indeed, this can occur even when it is impossible for the producer of the good to prevent such sharing.

Sharing can occur in two ways. The use can be sequential, as when magazines or books are passed on to other readers after they are read, or when prerecorded videocassettes are rented to a succession of viewers. Or the good can be used simultaneously by various users, as when computer programs are reproduced, or books or articles are photocopied, or when a fireworks display that is paid for by one set of consumers is viewed by those who do not pay to do so.

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[14]That is, a television station cannot offer only program guides.

[15]Some computer programs are sold bundled with "hardware," but the typical manner in which they are sold is as described in the text.

What are the characteristics of those types of intellectual property for which direct user purchases, although not necessarily optimal, are at least a feasible source of support? First, direct user purchases are more likely the lower is the price of the good, other things equal. Thus, for example, we do not observe as much sharing of daily newspapers as we do of professional journals, since the price of the former is so low that most consumers prefer to purchase their own original. By contrast, sharing of expensive computer programs is apparently the rule rather than the exception.

Second, other things equal, if the costs of forming a sharing group are high, the purchase of originals will be encouraged and direct user financing will be feasible. One suspects that sharing of special purpose computer programs is less prevalent than is the sharing of general purpose word processors or spread sheets, since identifying others with whom to share is more costly in the former case.

Third, other things equal, sharing is less likely the more easily can the producer prevent sharing. If it were inexpensive to exclude nonpayers from viewing a fireworks display, private support for such displays would be more prevalent than it is today. In the case of intellectual property, if sharing is a copyright infringement and if the cost of detecting and prosecuting infringements is low, direct consumer support is more likely. By contrast, if sharing is "fair use," or if enforcing copyrights is difficult, it is more likely that an alternative to direct user financing will have to be employed if the intellectual property is to be produced.

Fourth, other things equal, direct user support is more likely the easier it is for producers to charge different prices to different users, on the basis of differences in their "willingness to pay."[16] Moreover, for some goods, profitable operation will be possible only if price discrimination is practiced.

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[16]Technically, price discrimination involves setting prices higher the lower is the elasticity of demand. See, e.g., Henderson and Quandt (1958, pp. 170-172).

One set of suppliers of intellectual property that engages in price discrimination is publishers of academic journals, who are able to charge higher prices for institutional than for individual subscriptions.[17] Similarly, the publication of both hardback and paperback editions of some books permits higher prices to those who require early access than to those who are willing to wait. However, because of the "first sale" doctrine, producers of prerecorded videocassettes cannot charge different prices to individual consumers and the proprietors of video rental stores.

Finally, direct user support is more likely if producers can adjust the prices of those units sold directly to consumers to reflect the existence of sharing. In other words, if producers can raise their prices to reflect the fact that their products are being employed by more than a single user, they may be able to obtain enough revenues to be financially viable. Indeed, there may be circumstances in which sharing actually benefits producers, or at least does not reduce their profits.[18] However, even where prices can be increased to reflect sharing, producer profits may fall if the cost of adding an additional user of an original exceeds the additional cost of producing an original.

Of course, the viability of the strategy of increasing prices to reflect sharing depends on the ability of consumers to prevent nonpayers from using the public good. In other words, the success of the strategy is based upon a greater ability on the part of consumers than of producers to prevent free-riding. Thus, although it may be impossible for a computer software vendor to prevent the sharing of his programs through copying, if those groups that form to share the programs are

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[17]See Dyl (1983) for a discussion of the extent of this practice by journals in economics and business.

[18]Besen (1984, 1986) develops a model in which sharing can increase, leave unchanged, or reduce the profits of producers of intellectual property. A necessary condition for sharing to increase profits is that, for some users, the incremental cost of producing and distributing originals exceeds the incremental cost of producing and distributing copies. For other analyses of the effect of copying see Johnson (1985) and Liebowitz (1985).

able to police their members to prevent them from giving copies to nonmembers, this strategy may be effective. If, however, exclusion is no easier for consumers than for producers, a strategy of raising prices will not work, since the first purchaser cannot recoup the high price paid to the producer by obtaining payments from all of those who share his original. This suggests that the strategy will be most effective when the size of the sharing group is relatively small, or where all sharers are under common direction, e.g., they all are employed by the same firm. On the other hand, where the sharing groups become very large, preventing a member from sharing his copy with nonmembers becomes very difficult, so that the exclusion problem for the group is no different from that of the producer himself.

One other significant characteristic of the sale of intellectual property must also be mentioned here. For certain types of property, exploitation by the seller occurs over an extended period of time and in a variety of different markets. Thus, a novel may be serialized in a magazine, printed in hardback form, sold as a paperback, and adapted into a motion picture. Similarly, a motion picture may be shown in theaters, sold in videocassette form, distributed over pay television, carried on one of the networks, and syndicated to individual television stations. Some stages of the process may even be repeated, as when "classic" films that have already appeared on network television and in syndication are shown in theaters or on pay television.

This method of exploitation has two significant elements. First, by permitting the producer to draw upon a number of different sources of revenue, he can be expected to be willing to invest more in development than if his revenues were limited to a single initial market.[19] Second, this approach may allow producers to engage in some form of price discrimination, which, as we have argued above, is required for efficient production. Thus, for example, the existence of a paperback market permits, to some degree, charging higher prices to those customers who place a higher value on a book than do others.[20]

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[19]It should be noted, however, that the revenues from a "later" market are not necessarily net additions to the revenues obtained "earlier." For example, some purchasers of paperbacks would have purchased more expensive hardbacks if they had not anticipated the availability of the lower-priced editions.

[20]This is not to suggest that price discrimination can easily be accomplished or that the resulting prices are necessarily the efficient ones.

If the market for intellectual property is (monopolistically) competitive, the combined revenues from all sources will just cover the costs of producing the property, including a normal return on invested capital. . The inability to exploit an existing market can be expected to cause some suppliers to leave the industry and others to reduce the number or quality of the properties that they offer. A similar effect will be felt if a new market cannot be exploited.[21]

There are many examples of limitations on the ability of producers of intellectual property to exploit additional markets. The Federal Communications Commission restrictions on pay television limited revenues for motion picture production to those from theatrical distribution and advertiser-supported television. The "first sale" doctrine limits the ability of motion picture companies to exploit the video rental market. When other countries do not respect U.S. copyrights, revenues from those markets are denied to copyright owners. When cable television systems were not liable for copyright infringements when they retransmitted broadcast signals, television program producers were denied access to that market, and even now there is some question of whether the compulsory license fees paid by cable systems reflect the prices that would otherwise have prevailed in the marketplace.

SUPPORT BY GOVERNMENT OR NONPROFIT INSTITUTIONS

A substantial amount of the development of intellectual property is supported directly by government or nonprofit institutions. Indeed, it has been argued that such support is essential for certain types of intellectual effort, primarily basic research, where it is almost certain that private firms are able to capture only a small share of the benefits that their efforts produce. As a result, unless there is support from sources other than consumers, there is likely to be a substantial underprovision of such goods.[22]

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[21]Note that this does not mean that suppliers will incur losses. If production decisions correctly anticipate which markets can be exploited, the sole effect of foreclosing a market is to reduce the amount of intellectual property produced. Only where production decisions are based on incorrect assumptions about the markets available to producers will losses result.

[22]For a well-known statement of this proposition see Arrow (1962,

It seems clear that a very large proportion of all basic research is carried out in ways that are unrelated to the profit or loss of the organization doing the research or the organization supporting it. In 1984, for example, federal government support for research and development amounted to $44 billion.[23]

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p. 623) who argues that "for optimal allocation to invention it would be necessary for the government or some other agency not governed by profit-and-loss criteria to finance research and invention." He points out, however, that "If the government and other nonprofit institutions are to compensate for the underallocation of resources to invention by private enterprise, two problems arise: how shall the amount of resources devoted to invention be determined, and how shall efficiency in their use be encouraged?"

[23] *Special Analyses, Budget of the United States Goverment, FY1985*, at K-2. To be sure, not all research that is supported by government is basic research. Government support for other types of research may be justified, however, on the grounds that their benefits, like those of basic research, are nonappropriable, i.e., nonpayers cannot be excluded from them.

III. EFFECTS OF NEW TECHNOLOGIES ON THE BEHAVIOR OF PRODUCERS

Even when protected under the copyright, patent, and trade secret laws, the production and distribution of intellectual property is unlikely to be carried out in an economically efficient way. The nature of the goods being produced virtually guarantees that this will be so. The relevant public policy question is, therefore, not how can an economically efficient system to promote the supply of intellectual property be established, but how can a system that works in a satisfactory way be developed to achieve this objective.

For better or worse, the existing copyright, patent, and trade secret systems had previously adapted to the technologies in existence in ways that most parties found acceptable. Recently, however, a number of developments have called into question the ability of the existing systems to continue to balance the interests of producers and consumers of intellectual property. This section examines some of these developments to see how they are likely to affect the markets in which intellectual property is produced. The developments examined are: (a) the availability of low cost copying technologies; (b) the availability of telecommunications and computer systems that permit rapid access to large scale databases; (c) the development of widespread access to computer technologies.

COPYING

The right of an individual to copy by hand an entire book or article is seldom questioned. Yet the same copy, or one that is less extensive, made using a modern photocopying machine becomes the object of an intense debate about the respective rights of copyright holders and consumers.[1] And with the increasingly widespread copying of computer programs, using personal computers, or prerecorded audio or

[1]Libraries and publishers have developed guidelines that set out the conditions under which photocopying for interlibrary loans does not infringe the rights of copyright holders. See National Commission on New Technological Uses of Copyrighted Works (1979, pp. 54-55.) In a well publicized case, a number of publishers brought suit charging that

visual material, using tape or videocassette recorders, the debate has spread from the copying of printed material to encompass many other forms of intellectual property.[2] Despite the intensity of these debates, however, the effect of copying, on both producers and consumers, is not widely understood.

Most discussions of copying characterize it as producing a conflict between the interests of producers and consumers of intellectual property. Copying, it is thought, benefits consumers by permitting them to obtain copies at less than the cost of purchasing originals. Copying, it is thought, harms producers by reducing the number of originals that are sold. In this view, if additional copying is permitted, say by extending the scope of fair use, the welfare of producers declines and that of consumers increases.

One shortcoming of this argument should be readily apparent, however. If producer profits decline, it is reasonable to expect that fewer "first copies" will be supplied, at least in the long run. Presumably those who recognize this relationship but still defend copying would argue that the value of the reduction in the number of first copies is small relative to that of the increase in consumer welfare that comes from the more widespread availability of those properties that are produced.[3]

A second shortcoming of the argument is more subtle. It results from the fact that producer behavior is likely to be affected by the existence of copying in ways that may offset any gains to consumers that result from copying. For example, under certain circumstances, an appropriate, i.e., profit-maximizing, response by producers to the existence of copying is to increase the price of originals.[4] If copying

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high-volume copying of their works constituted an infringement. See *Addison-Wesley Publishing Co., Inc. et al. v. New York University et al.*, Complaint filed in the United States District Court, Southern District of New York, December 14, 1982. The case was settled when the defendants agreed to a number of restrictions on their behavior. See "NYU and publishers strike accord in out of court settlement," *Library Journal*, June 15, 1983, pp. 1185-1186.

[2]See Davies (1983) for a discussion of the controversies surrounding the copying of audio and video recordings and Tyler (1986) for a discussion of the issues involved in computer software copying.

[3]This is, in fact, a variant of the argument made by Plant (1934a, 1934b).

is inefficient, i.e., the marginal cost of a copy exceeds the marginal cost of an original, this will actually raise the price of using a copy above the price that would have been charged for originals in the absence of copying. In these cases, copying actually makes both consumers and producers worse off.[5] Here, the commonly held view that the interests of consumers and producers necessarily diverge is not correct.

If private copying is efficient, at least in the short run it makes both consumers and producers better off. In this case, the effect of copying is to reduce the cost of using the intellectual property to consumers, but, because it is efficient, producer profits also increase. Here, as in the previous case the interests of producers and consumers are congruent.

Finally, where private copying is inefficient, the profit-maximizing response of producers may be to *reduce* rather than raise prices. Consumers benefit from the lower prices, but producer profits decline. Here, the commonly held view that the interests of producers and consumers diverge is correct.[6]

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[4]For a model in which this can occur see Besen (1984, 1986). A critical assumption is that the cost of originals and the cost of making copies are divided equally among the members of the group that "shares" an original.

[5]One might ask why copying occurs if it harms consumers. The reason is that consumers are unable to enter into enforceable agreements not to copy, so that copying will occur even if the price of originals is not increased. As a result, producers assume, correctly, that copying will occur and raise the price of originals accordingly.

[6]The results reported in the text are based on a model in which all originals result in the same number of copies. Where this is not the case, the conclusions are more complex. For example, efficient copying can make producers and at least some consumers worse off, if all consumers do not engage in copying. And, some consumers may be better off even if they engage in inefficient copying, if other consumers do not copy. A critical assumption is that producers cannot engage in price discrimination, charging higher prices to those consumers who copy than to those who do not.

It should also be noted here that the analysis of copying applies to other instances in which originals are shared, for example the rental of prerecorded videocassettes. As noted above, the "first sale" doctrine prevents producers from charging prices to operators of video rental stores that are different from the prices charged to consumers who purchase prerecorded cassettes for their own use. As a result, profits may be lower than if video rentals were not permitted. If price discrimination were possible, the prices charged to video rental stores would rise and those to individual consumers would decline.

Changing prices in response to the existence or the threat of copying is not the only possible strategy available to the producers of intellectual property. One alternative, or complementary, approach is to design products in ways that make copying more difficult. For example, computer software vendors are presently undertaking extensive efforts to develop technical schemes for "copy-protecting" their products.[7]

What is significant about schemes for technical protection is that they interact with the pricing strategy adopted by the firm. If, for example, the existence of copying induced firms to raise their prices, and if copying can be prevented, or limited, by technical means, prices are likely to fall. This will increase consumer welfare and producer profits in the short run, since presumably producers will not wish to prevent efficient copying. Where producers lower prices to discourage copying, however, effective technical "fixes" will raise prices and make consumers worse off.[8]

A third strategy available to producers is to update their products more frequently than they would in the absence of copying. This is akin to the efforts by some textbook publishers who publish revised editions on a frequent basis, at least in part to undercut the market for used books.[9] If "upgrades" of computer software are made available on a frequent basis, and if there is value to having the latest version, more consumers will acquire originals instead of copies than if upgrades occurred less frequently. As in the case of technical "fixes," adopting this strategy may permit a lower price to be charged for originals.

Finally, producers can be expected to attempt to prevent unauthorized copying by bringing legal actions against infringers.[10] The effectiveness of such a strategy will depend upon the ease of

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[7]For a comprehensive description of the types of technologies being employed, see Iscoe (1986).

[8]There may also be significant distributional consequences. If technical protection schemes can be defeated by some consumers but not others, their existence may benefit some consumers while making others worse off.

[9]See Miller (1974) for an analysis of this phenomenon.

[10]See "Lotus Settles in Copying Suit," 6 *Infoworld*, October 29, 1984, p. 24; "Maryland Firm Agrees to Pay in Computer Software Piracy Suit," *Washington Post*, *Washington Business*, March 19, 1984, p. 15; and

detecting infringing uses and the magnitude of the penalties that can be levied on infringers. It is probably the case that copying by individuals for noncommercial use, or copying in relatively small business establishments, will be difficult to detect. Widespread copying within large firms may be more easily identified. If copying can be limited in this way, the price of originals may be lower than otherwise. This will benefit those who did not previously copy but may make copiers worse off.

ACCESS TO DATABASES

One type of intellectual property that has become increasingly important in recent years involves the amassing of large amounts of information from a variety of sources in a form that makes accessing it relatively simple. The data can be in a variety of forms. They may involve the compilation of legal citations, or economic time series, or the texts of articles from the periodical literature. In each case, a user is saved the trouble of searching a large number of widely dispersed sources to obtain the limited amount of information that is actually needed. The firm that compiles the information and puts it in a form that facilitates access to it clearly supplies a useful service.[11] However, such a firm may be unable to be compensated for the services it provides if users can quickly and cheaply "download" all, or a large portion, of a database to be used later without additional payments to the vendor, or to be sold to other potential users.

Modern technologies make possible the sale of data on a usage basis. Without the ability to cheaply and easily monitor usage, the only way in which data can be sold is to make an entire database available for a fixed price. Computer technologies that permit usage to be measured make it possible to charge discriminatory prices and, perhaps, to provide data more efficiently. However, this advantage may be overcome by developments that lower the costs of communications and data storage.

"Software Industry Escalates Its Battle on Program Piracy," *Wall Street Journal*, January 18, 1985, p. 4, for examples.

[11]The relationship between compilers of databases and the publishers of the materials that are compiled is considered below in the section on Derivative Works.

In an important sense, the problem of downloading has much in common with the issue of copying, discussed above. Efficient production of databases occurs where the value that consumers collectively place on having additional data available just equals the cost of providing it. Generally, access to a database will be valued differently by different users, and efficient provision may require price discrimination. This can be accomplished, at least roughly, by charging consumers on the basis of the intensity of their use of the database, with heavy users paying more than light ones.[12] However, if users can acquire an entire database in a single transaction, to be searched later at their own convenience, the ability to discriminate may be lost. Similarly, if one consumer makes access to a database available to others, the latter cannot be charged anything by the original vendor. The only pricing strategy available may be to charge high annual subscription rates, surrendering control over use to others.[13]

The ability of a database vendor to practice price discrimination depends not only on the available technology, but also on the type of information being provided. If the data must be continually updated, the costs of downloading will have to be incurred frequently, so that it may be cheaper to acquire only those data that are needed. Here, sharing of data among users, or a strategy of "download and store," may be uneconomic.[14] Where data must be current to be useful, therefore, it is more likely that charges based on usage will be sustainable.[15] This

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[12]Prices based on usage can only approximate the value of the data, since the same information will be worth different amounts to different users.

[13]There are, of course, other strategies, akin to copy protection schemes employed by computer software vendors. For example, some data base vendors have apparently reduced the rate at which data can be accessed, even though this increases acquisition costs, to discourage downloading. Others charge different prices depending on the rate at which data are accessed. Still others have bundled data with complementary inputs, e.g., computer software and economic models, so that customers obtain "results" rather than "data."

[14]Of course, if the costs of communications and storage are sufficiently low, these strategies may still be preferred to one in which data are acquired only as needed.

suggests that contemporary economic time series, or current legal citations, or information from the periodical literature may be protected more easily than can historical records or data.

DECENTRALIZED ACCESS TO COMPUTER TECHNOLOGIES

Until the last few years, computers were either sold "bundled" with the software required to operate them or individual users developed their own programs.[16] In those cases where programs were developed to operate on many machines, it was usually straightforward to determine whether a particular program was being operated on a particular machine--typically its availability was "advertised" to the computer's users. Moreover, the identity of the developer or author of a particular program was relatively easy to discover. During this period, disputes about the ownership of programs and about the liability of users to developers of software were rare.

More recently, however, first with the development of minicomputers, and more significantly with the widespread use of personal computers, this situation has changed. The change has several dimensions. First, there has been an enormous increase both in the number of computer users and in the number of separate locations at which computers are operated. Second, there has been a substantial separation between the firms that manufacture computer hardware and those that develop software. Where computer manufacturers previously had felt it necessary to develop software to run their machines and to permit users to employ them, or users developed their own software, an entire industry now exists to provide software to computer manufacturers and users that do not develop any software of their own. In this connection, there has been a large increase in the number of general purpose programs--word processors, spread sheets, database managers, and the like. Previously, most users were required to develop their own applications software.

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[15]This, too, has a parallel in the case of copying. Where, for example, a computer program is being continually modified and updated, consumers are more likely to purchase the product directly from the publisher, rather than sharing with others, with the inevitable delay in obtaining the most recent version.

[16]Of course there were exceptions. One example was the widespread use of multivariate statistical packages on mainframe computers.

Third, the substantially reduced cost of employing computers has made it possible for a very large number of individuals to participate in the development of computer software. Where once the development of software was carried out by the employees of a small number of firms, many users are today potential developers and sellers.

The separation of the development of hardware from that of software, combined with the highly fragmented character of the software industry, has led to a problem that did not exist, or was extremely small, when software was marketed together with the mainframe computers on which it operated, or was developed by users for themselves. Firms that produce software must today earn enough revenues on software sales alone to compensate them for the costs of both the development and the production of their products. Even if we ignore the issue of private copying, i.e., copying by users, a computer software vendor faces the problem that other firms will be seeking to market products similar to his own and these may have been developed, at least in part, based on the contents of his own product. If a firm's development costs are reduced because it is able to "piggyback" on the ideas of others, its costs are reduced and its competitive position is improved.[17] But if such emulation becomes widespread, the incentives for the development of software may be reduced, since many of the benefits of innovative activity will be captured by other firms.

Firms faced with the possibility that others may emulate their products and bring them to the market at lower costs have a number of alternatives open to them. First, they may limit themselves to the development of products for which the advantage of being first is sufficient to generate revenues that cover all costs, including the costs of development.[18] This means that they must be able to satisfy a large demand during the period before their rivals can enter, for

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[17]In the extreme case, other firms may simply copy, or make minor modifications in, the initial developer's product, and attempt to market the product as their own.

[18]Thus, even if Plant (1934a) is correct that some production can occur without copyright, other products, less easily protected through "self-help," may not be made available.

otherwise their first entrant advantage may be lost. They may also wish to undertake strategies that make entry by other firms more difficult, for example, by setting prices lower than those that would prevail if there were no threat of entry.[19]

Second, developers may undertake strategies that make "emulation" more difficult. By limiting documentation, by providing only object code, and by making available only the minimum information required to obtain a copyright or patent, the period of time over which the first entrant advantage may exist may be extended.

Finally, creators may bring legal actions for infringement against rivals. This strategy is costly to undertake, and may be difficult to sustain, but is likely to be part of the approach taken by firms against "emulating" rivals.[20]

CONCLUSION

Even where the law provides no protection to the creators of intellectual property, or where the enforcement of legal rights is difficult, producers of such property are not without means of protecting their interests. The effectiveness of these "self-help" efforts will vary among products, but in many cases they will be sufficient to sustain the viability of the producer. This does not mean, however, that there is no reason to extend legal rights or to facilitate their enforcement. The various efforts to protect intellectual property discussed in this section may not be equally effective for all producers. Moreover, they involve real resource costs, or the introduction of inefficiencies, that would not be present if rights in original creations could be more easily protected. Analyzing whether to create a right, or to promote the enforcement of an existing right, cannot be complete, therefore, unless these costs are taken into account. Thus, in analyzing the effect of reduced copyright or patent protection that is intended to make intellectual property more freely available, one must understand how producers will respond by

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[19]For a discussion of this strategy see Spence (1981).

[20]See Note (1983) for a useful discussion of legal protection of computer software.

seeking protection in other ways and how effective these responses will be. It may often be more efficient to provide legal protection to creators than to require them to protect their interests through other means.

IV. ECONOMIC EFFECTS OF THE LEGAL TREATMENT OF AUTHORS, PUBLISHERS, PACKAGERS, AND DISTRIBUTORS

Much of the literature on the economics of intellectual property treats the process of the development and sale of such property as if an author/publisher/distributor markets his wares to an easily identifiable collection of users. In this simplified view, no distinction is made among the various components of the development process, implicitly treating them as if they are a single entity, or as if their interests are completely congruent. At the same time, users are treated as if they purchase and employ the product but play no role in its development. There are important reasons why the usual economic paradigm, in which firms produce and users consume, may not be entirely appropriate in characterizing the intellectual property industry. One such reason is the fact that development occurs in many stages, not always within the producing firm. As a result, identifying a particular entity as either a producer or consumer is not always straightforward.

RIGHTS OF "AUTHORS" AND "PUBLISHERS"

First, let us consider the effect of separating the interests of the "publisher" from that of the "author" of intellectual property.[1] For the moment, we abstract from the existence of uncertainty in the activity undertaken by the author. That is, we assume that the product that will be produced by the author is known before he undertakes his creative activity, and that the value that users place on the product is also known. We assume, further, that there is competition among publishers for the service of authors and among authors for the opportunity to be published. Under these assumptions, the return to the author will be the same whether he is an employee of the publisher or an independent contractor. Competition for his services will drive his "wage" to the value of his marginal product.

[1]The designations "publisher" and "author" are used for convenience. They could as easily have been "manufacturer" and "inventor," or "producer" and "performer."

Now let us introduce uncertainty about the outcome of the author's creative process and about the value that consumers will place on it. Assume, however, that the probability distribution of outcomes is known to both author and publisher. That is, they know the possible values that may exist and the probability that each will occur. Now the determination of the return to both parties, and the form in which it will be obtained, is more complex. For example, if the author is risk averse, so that he desires an income that is not dependent on the outcome of his efforts, he can become an employee of the firm, at a fixed wage. Here, the publisher will obtain a large return if the author's efforts are highly successful but will incur losses if his efforts fail. The wage that the employee is paid may fall short of the expected return from his efforts, if publishers are also somewhat risk averse. If, however, many publishers are risk neutral, so that they are concerned only with the *expected* outcome, the amount of each outcome times the probability that it will occur summed over all outcomes, competition among them for the services of the author will produce a return for him that is equal to the expected return from his efforts. This is the same as the wage he would have received had there been no uncertainty.

Suppose, however, that the author wishes to gamble on the success of his efforts. Instead of working for a fixed wage, he can offer his product to the publisher on a consignment, or royalty, basis, so that he receives little or no return if his product fails and a large return if it succeeds. Alternatively, he can be employed by the firm, but in a way that makes his "wage" dependent on the success of his efforts. If the author is less risk averse than is the publisher with whom he contracts, this will be the preferred alternative for both parties.

In addition to relative risk averseness, another factor that may determine the way in which authors are compensated is that they may have better information about the value of their works than do their publishers, especially where contracts are executed before the completion of manuscripts. Since a publisher is likely to discount the claims made by authors, an author who believes that his work is more valuable than does the publisher may prefer a contract in which his

payment depends on the success of his work, even if he is quite risk averse. Indeed, his willingness to accept such a contract provides a signal that he believes his work will be successful and thus makes the publisher more willing to publish it.[2]

Finally, the contract must reflect the fact that the manner in which the author and publisher obtain their rewards may affect both the creative efforts of the author and the efforts of the publisher to market his creations. For example, it is not reasonable to assume that the efforts expended by the author are the same whether he works for a fixed wage or has his income depend on the success of his efforts. Similarly, the resources that the publisher expends in marketing will be greater if he need not share additional revenues with the author. What is produced, and how it is distributed, are likely to be affected by the compensation arrangement between publisher and author.[3] As a result, the way in which an author is rewarded will depend not only on the willingness of the two parties to bear risk, but also on the need, that both will perceive, to encourage the other to expend his "best efforts."[4]

Where there are no legal impediments to contractual arrangements between author and publisher, we can expect the parties to arrange their affairs so as to allocate more of the risk to the party more willing to bear it, taking into account the need to assure good performance on both sides. The arrangement for risk sharing is unlikely to be "perfect," in

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[2]I owe this line of argument to Herman Quirmbach. The phenomenon described here has been called "information impactedness" by Williamson who defines it as existing "in circumstances in which one of the parties to an exchange is much better informed than is the other regarding underlying conditions germane to the trade, and the second party cannot achieve information parity except at great cost - because he cannot rely on the first party to disclose the information in a fully candid manner." Williamson (1975, p. 14).

[3]The literature on the principal-agent problem, of which the arrangement discussed here is an example, is voluminous. For a good introductory survey see Pratt and Zeckhauser (1985).

[4]For this and other reasons, we would expect the wages of successful employee-authors to be renegotiated even in the absence of an explicit contractual provision to do so. This phenomenon, which also occurs in the cases of the salaries of professional athletes and television performers, is analyzed in Klein (1980).

that one of the parties is likely to end up bearing more of the risk than if there were no need to assure good performance. But the parties can be expected to do the best that they can under the circumstances. The question naturally arises as to how legal considerations affect this outcome. There are basically two cases.

In the first, the parties are free, if they desire, to shift rights from those that the law stipulates to others that the parties prefer. Thus, suppose that the law specifies that all work done by employees of a firm belong to the firm, unless the parties specify otherwise. If there is no arrangement to the contrary, an author-employee will work for a fixed wage, since he does not share in the ownership of the work. If, however, the publisher does not wish to bear all of the risk of failure, or if he wishes to create additional incentives for the author to be innovative, he may make part of the employee's reward depend on the success of his efforts. This can involve an explicit share of the returns from the products that the author develops. Alternatively, the arrangment can be implicit, as when authors who produce especially valuable products receive higher wages. In either case, the parties have agreed to give to the author some of the rights that the law has provided solely to the publisher. By a similar token, if the law provides that authors own all of the rights to their products, we can expect either that firms will not pay them a wage, or authors will attempt to obtain a wage by transferring all or a portion of their rights to publishers.

But what if there can be no transfer of the initial assignment of rights? Take the case where the law assigns the rights to the author. An author who wishes to bear less of the risk of success or failure, and obtain a larger proportion of his income in the form of a fixed wage, cannot do so if he is unable to transfer all or part of the ownership to the publisher. He must, therefore, accept more risk than he would prefer, since he cannot shift risk to the publisher. Similarly, if the law specifies that a publisher owns all of the products of his employees, and cannot transfer any of these rights to the authors, he may bear more risk than he would like, since the risk cannot be transferred to the authors. Moreover, it may be difficult in these circumstances to create appropriate incentives for creativity by authors, since their reward is independent of their efforts.

A similar analysis applies where the law restricts the rights beyond the first use that can be transferred to the producer. Where the producer can acquire these rights, he may do so and pay performers a higher initial wage than if such rights could not be acquired. Where performers must retain these rights, however, their wages can be expected to fall by the value of the rights that are retained.[5] If there is no uncertainty, only the form in which the performers receive wages changes, with smaller payments from the initial producer being offset by the payments for the rights that are retained. If there is uncertainty, performers may bear more risk than otherwise.

One way to avoid this problem would, of course, be for all authors to be independent contractors, so that their products would not be works made for hire. By paying authors "advances" and giving them a share of the proceeds from sales, the effect of a work made for hire rule without transfers may be avoided. The success of this arrangement depends on whether it would be regarded as a subterfuge to avoid the effect of the law. Still another way that the difficulty might be avoided would be to make clear to author-employees that their future wages depend on the success of their present efforts.

The conclusion of this analysis is that, so long as rights can be transferred, there is no significance to their initial assignment. If the initial assignment places too much of the risk of the success of the venture on one party, subsequent negotiations will result in a transfer of some of the risk to the other.[6] Only where the law restricts transfers can the initial assignment significantly affect the outcome.

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[5]Another example of a restriction on the transfer of rights is the "droit de suite" under which an artist obtains a royalty each time his work is resold. This right cannot be assigned to a purchaser "presumably to protect the artist who may otherwise be persuaded or forced by poverty to assign it to the first buyer." See Stewart (1983, pp. 121-122).

[6]This assumes that the costs of consummating transactions are not great. Where such costs are large, the final distribution of rights will be the same as the initial assignment. Such an outcome seems unlikely for dealings between "authors" and "publishers."

One important example of a restriction on the transfer of rights occurs in the case of network television programs. Federal Communications Commission rules prevent the three major television networks from acquiring rights in the syndication of programs produced by independent suppliers after they have appeared on the network. Before the adoption of the financial interest and syndication rules, it was a common, although not universal, practice for the networks to acquire, at the time that a contract was negotiated for network exhibition, the right to act as the sales agent for the program in the off-network syndication market and to share in the revenues from off-network exhibition. Such practices are now forbidden by FCC rules, so that a supplier that wishes to reduce its risks by accepting a larger proportion of its return at the time the initial deal is struck cannot do so. However, the networks are able to acquire other rights in the programs, e.g., foreign exhibition, associated merchandise sales. The financial interest and syndication rules do, however, represent an example of a restriction on the transfer of rights in intellectual property.[7]

One additional point should be noted here. The previous discussion proceeds on the assumption that the uses of a product are known at the time that the contract between author and publisher is being negotiated. However, "changes in technology...may allow [a] work to be exploited in a completely new fashion beyond either party's anticipation at the time the work was created."[8] The result is that the initial assignment of rights may govern such unanticipated uses, since no one will have thought to negotiate specifically for them at the time of the initial contract. Thus, an employer-publisher may own all rights to a product except those specifically transferred to an employee-author, so that all windfalls that arise from unanticipated uses accrue to the publisher.

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[7]The rules were initially justified by the FCC on the grounds that they prevented the exercise of monopsony power by the networks in their dealings with independent suppliers. For a criticism of the rules see Besen et al. (1984).

[8]Government of Canada (1984, p. 114).

Suppose, however, that it was believed that there would be some unanticipated uses of a product, but that it was not known precisely what these uses would be. Under these circumstances, the author could presumably either negotiate a higher wage than if these potential uses did not exist, or he could contract for a share of the earnings from all uses not specifically designated in the employment contract, or he could reserve rights in all unspecified uses for himself. Thus, the fact that all future uses of intellectual property cannot be anticipated does not necessarily mean that such uses cannot be taken into account in contracts between authors and publishers.[9] The relevance of legal treatment extends only to instances where the respective rights of the author and publisher have not been specified in the contact between them, or where the law restricts the rights that can be transferred.

It is also important to recognize why publishers might negotiate for a broader range of rights than the right of first publication, and why authors might grant them. One reason is that authors, by transferring rights to publishers, are able to reduce the risk that they undertake. To the extent that publishers can more easily bear risk than authors, because publishers' exposure is spread over a number of different products, both parties can be made better off by the transfer. In addition, since publishers' efforts may be important to the success of their venture, by permitting them to share in the rewards these efforts will be encouraged. It may be in the interest of authors to permit publishers to share in rights beyond those of first publication, if the publishers' efforts can affect the value of such rights.

Some publishers routinely obtain rights beyond those of initial publication. For example, it is standard practice for television networks to obtain the right of first refusal to "spinoffs" that result from series that they air. However, it is not standard for print publishers to retain the motion picture or television rights to books

[9]This is not to suggest that assigning values to uses that are unknown at the time of the initial negotiation is straightforward. But the fact that such uses may arise is known and can be incorporated into the calculus of the negotiating parties. One party can agree to accept a larger initial payment in return for surrendering all "windfalls" to the other.

that they publish. One possible reason for the difference is that a network's contribution to the development of the characters in the spinoff is more important than the contribution of print publishers to the value of potential film rights. Granting some rights to the network may thus result in greater effort on its part in the development process.

It should be clear that the issue being considered here is quite general. Among the situations to which it applies are:

(a) the development of computer software, where the question involves the way in which the authors of software and the firms that market and distribute their products divide the revenues from their sales;
(b) the authorship of books, where the question involves the rights retained by authors in subsequent uses and those sold to the initial publisher;
(c) the production of motion pictures, where the question involves the rights retained by independent producers and those transferred to film distributors;
(d) the production of network television programs, where the question involves the rights retained by producers and those transferred to the networks;
(e) the production of artistic works, where the question involves whether the artist can share in the revenues from sales beyond the first; and
(f) the invention of technical processes or new products, where the question involves the rights retained by the inventor and those transferred to the user of his inventions.

In all of these cases, with rights freely transferable, the returns to both "author" and "publisher" are unaffected by the way in which legal rights are defined. If the law does not permit some rights to be transferred, and if there is certainty about returns, the payment for other rights will be adjusted so as to leave the returns to both parties unaffected by the legal definition rights.[10] If there is uncertainty,

[10]This could, in principle, result in a negative wage being paid to

and rights cannot freely be transferred, one party may bear more risk than is optimal.[11]

DERIVATIVE WORKS

The creation of knowledge is a cumulative undertaking. An author, or scientist, or inventor is more productive because of the activities of those who have come before him. If those who create cannot take advantage of the work of others, the process of creating intellectual property would be far less efficient. However, if this involves a reduction in the return to earlier creators, the process of creation may be slowed.[12] The problem is how to balance the need to permit building upon previous knowledge against the need to encourage creativity in the first place.

Note that the problem of balancing does *not* occur under two sets of circumstances. First, if all users of a given set of knowledge are employed by the same firm, it is in the interest of the firm to permit unlimited use of the knowledge created by any employee. Since all of the benefits of unfettered use are internal to the firm, there is no reason for the firm to limit the ability of any employee to appropriate and build upon the work of any other.

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the author. Thus, for example, if the sale of movie rights is contingent on the publication of a novel, the author may have to pay for the book to be published if he cannot assign the movie rights to the publisher. Television program producers routinely accept payments for network television distribution that are less than their costs, because additional revenues may be obtained in the off-network syndication market.

[11]Still another possible case, not considered here, occurs where the law specifies not only that a right exists but also its value. This occurs, for example, if performers are granted inalienable rights in subsequent performances, say in jukeboxes, and the royalty payment for such performances is specified by law. Here, if the required payment exceeds the amount that would be determined by the market, the revenues obtained by performers can be either larger or smaller than if the value of the right were not specified, depending, in part, on the effect of the royalty on jukebox uses. For an analysis of this issue see Globerman and Rothman (1981).

[12]Creators may also attempt to keep their works secret, although that is a far more feasible strategy for industrial processes than for consumer products.

Similarly, there would be no need to balance the interests of creators and users if there are no impediments to contracts among them. Thus, for example, if the creator could prevent any use of his product, a user who wishes to take advantage of earlier efforts can negotiate, and pay for, the right to do so. All benefits would be "internalized," as in the case where all activities take place within a single firm. Where access to information is especially valuable, and where there are no close substitutes, it will command a high price. And producers of information will be able to charge different prices to different users, depending on the value that they place on it.

Of course, for reasons previously discussed, the assumption of costless transactions is not plausible for intellectual property. Negotiation over price requires knowledge of the value of the information being sold, but once the information is disclosed there may be no need to pay for it. And even if the law requires some payment, once disclosure occurs the buyer has an incentive to misrepresent the value of the information to him to pay a lower price. It follows that we cannot rely on private transactions alone to assure that the use of previously developed information is optimal.[13]

Resolving the question of how to balance the need to encourage creativity against the need to permit widespread use of information is not easy. Although stating the principle that should guide the balancing is straightforward--provide protection to the point where the value of the additional knowledge created equals the reduction in the value of the usefulness of the knowledge caused by the restriction--applying it in particular cases is extremely difficult.[14] What the law must attempt to determine is which uses would occur if transactions between creators and users were costless.

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[13]One implication is that the extent of vertical integration, the combining of different "stages" in the productive process within a single firm, will be more extensive than if private transactions could easily be consummated.

[14]Note that the approach is an "ex ante" one, of the type that Easterbrook (1984, pp. 21-29) suggests. The concern is less with how to reward creators for ideas that have already been produced, but rather with the effect of the system of rewards on the amount of creativity that will occur in the future.

The legal system has had to confront, and deal with, similar problems in the past. For example, determining whether the original author should have the right to control translations of his work is an instance of the problem of balancing. And the copyright doctrine that it is "expression" and not "ideas" that is protected is an instance where the courts have struck the balance heavily in favor of users. The development of new technologies may have made the balancing more difficult by making distinguishing between creators and users more difficult.

In a larger sense, however, the distinction between the use of information by final consumers and its use by those who wish to build upon it, so-called "productive" uses, is somewhat artificial. Airlines use information about weather conditions as an input to the provision of travel services; weather services use the same information to provide improved or specialized weather analysis that they sell to others. Most users employ information as an input to some other activity, so that even consumers who employ the Yellow Pages are using the information that it contains in the provision of "shopping," or "dining," or "entertainment." Whether purchasers convert information into another form and sell the resulting product to others, or whether they use it within the purchasing household or firm, does not fundamentally change the issue. Thus, the traditional notion that fair use must be confined to "productive" uses, those where the information is converted to another form, is inappropriate. The use to which information is put is, by itself, irrelevant to the required balancing. Only if it is believed that denying access to "productive" users imposes larger costs than does denying it to final consumers is the traditional distinction a tenable one. Thus, in principle, a nonproductive use might be held free of liability and, by the same token, a productive use need not escape liability on that ground alone.[15]

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[15]For similar reasons, the fact that a user is a nonprofit institution, as opposed to a profitmaking firm, should not be a consideration in determining whether liability should be imposed if promoting economic efficiency is the objective.

In addition to the question of whether or not to require the permission of the copyright holder to create derivative works, there is the issue of whether unauthorized uses can be prevented. Recent technological developments may make it more difficult for copyright owners to enforce claims against producers of derivative works, even where the law provides for them to do so. The reason is that "derivative works" are often produced and marketed in ways that make their sources difficult to identify.

Consider the following hypothetical case: One firm makes long-run weather forecasts that it sells to farmers, who employ the forecasts to aid them in making planting and harvesting decisions, as well as to other customers. An agricultural advisory service develops a computer algorithm that combines the weather forecasts with forecasts of the prices of agricultural commodities, data on the costs of various farming inputs, and information about a particular farm, to produce planting and harvesting recommendations. This results in a decline in the sales of weather data, since the purchases of weather data by many farmers are replaced by a single sale to the advisory service. However, the weather forecaster is unable to identify the advisory service as the source of its lost sales, since the output of the advisory service is planting and harvesting recommendations and not weather data. In short, the transformation of the weather data has been so complete that its role in producing the recommendations cannot be traced.[16] And, even if the forecaster knows that it is the advisory service that has caused the lost sales, it may have considerable difficulty in convincing a court that this is the case.

To try to limit the use of its forecasts in ways for which it receives little or no compensation, the forecaster may integrate "forward" into the provision of advisory services. Since it is advice and not weather forecasts that are sold, no one else can use the forecasts to provide advice.[17] Alternatively, if the viability of the

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[16]See Pool (1983, pp. 212-216) for an interesting discussion of the copyright issues raised by the ability to use modern computers to copy, modify, and expand a given "text."

[17]This assumes that sales of weather forecasts are completely curtailed.

weather service is threatened by the decline in its revenues, the advisory service may be forced to integrate "backward" into weather forecasting, to obtain a needed input.[18] As a result of the difficulties in detecting and preventing unauthorized uses, therefore, there may be more vertical integration than would otherwise be the case.[19] In the extreme, weather forecasting services that do not provide advice and agricultural advisory services that do not forecast the weather may simply cease to exist.[20]

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[18]This has some of the characteristics of the "bundling" strategy described above. A private good, advice, is combined with a public good, weather forecasts, to permit the financing of the latter.

[19]Even if the uses are authorized, vertical integration may occur if the return to the forecaster is thereby increased, since, from the point of view of the forecaster, there is no difference between an unauthorized use that cannot be prevented and an authorized use for which no compensation is received. That is, even if the balance is struck in favor of permitting some uses without authorization, creators can be expected to seek to prevent such uses.

[20]There are, of course, limits to vertical integration. To pursue our hypothetical case, because weather forecasts are useful in a variety of endeavors, it may not be feasible for forecasters to integrate forward into all of them. An alternative would be for forecasters to enter into exclusive arrangements with those firms that combine the forecasts with other inputs to provide various services. Final customers would receive only the services.

V. ESTIMATING THE HARM FROM UNAUTHORIZED USES

Many owners of intellectual property recently have advanced claims of substantial economic losses as a result of unauthorized uses made possible by new technological developments. This section presents and criticizes a number of these estimates, but before doing so it is useful to address the question of why such estimates are needed.

If the sole remedy sought by owners of intellectual property were the injunction of unauthorized uses, estimates of harm would be entirely unnecessary. A household or firm wishing to make use of such property would be forced to reach an agreement with the property owner. There would be no harm to assess because owners would authorize uses only if they were made better off as a result.

There are, however, two reasons why estimates of harm may be necessary. First, if unauthorized uses occur before they can be enjoined, or if an injunction is held to be an inappropriate form of relief, the resulting damages to owners will have to be calculated. Posner (1977, p. 51) argues that "in conflicting use situations in which transaction costs are high, the allocation of resources to their most valuable use is facilitated by denying property rights holders an injunctive remedy against invasions of their rights and instead limiting them to a remedy in damages.... Where transaction costs are low, injunctive relief should normally be allowed as a matter of course...." Where an injunction is not the appropriate remedy, the harm suffered by copyright owners will have to be assessed by the courts or by an administrative agency.

Second, as we have argued above, in determining the appropriate level of protection to afford owners of intellectual property, it is necessary to balance the need to promote creative activity against the desire to have the products of that creativity achieve widespread use. Striking this balance requires the determination of the effect of a change in the level of protection on the rewards to creative activity, since that is an important determinant of the amount of such activity

forthcoming. Estimating the harm that results from a reduction in protection is, thus, a necessary element of the balancing process.

A DIGRESSION ON THE MEANING OF HARM

One issue that must be addressed in determining the extent of harm is how to define it. Two possible definitions are suggested. Under the first, harm is measured by the reduction in the profits of the producer below their level before a new unauthorized use. Under this definition, harm does not occur if the unauthorized use leaves profits from all previous uses unaffected.[1] Thus, if books are sold only in hardback form, if a firm other than the initial publisher issues an unauthorized paperback version, and if it can be shown that hardback sales are unaffected, under this definition there is no harm. Similarly, if it can be shown that the retransmission of broadcast signals by cable television systems does not affect advertising revenues, or that none of those who copy a computer program would have purchased an original, under this definition the producer has not been harmed.

Under a second definition, harm occurs if the new use reduces profits below the level they would have reached had the producer been able to exploit the market served without authorization. To pursue the previous example, even if it could be shown that an unauthorized paperback edition did not reduce the profits from the sale of hardbacks, the profits that the publisher could have earned from paperback sales is a measure of the harm that results from their unauthorized publication.[2]

Clearly, these alternative definitions can give very different answers to the question of whether an unauthorized use has harmed the property owner. The distinction between them must be kept in mind in examining various claims of harm.

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[1]The Supreme Court majority in the Betamax case, *Sony Corporation of America et al. v. Universal City Studios, Inc. et al.*, 104 S.Ct. 774 (1984), appears to employ this definition, since in assessing harm from off-air taping it is concerned solely with whether taping reduces advertising revenues.

[2]An even more complicated situation arises where the invention that permits the unauthorized use also makes it possible for the publisher to exploit new markets. Thus, the availability of the VCR, although it permits off-air taping without the consent of the copyright holders of television programs, also makes possible the sale of prerecorded videocassettes.

SOME ESTIMATES OF HARM

This section provides some estimates of harm that have been presented by copyright owners in support of claims that additional protection is needed. Not all such estimates are presented, and attention is directed primarily to instances where serious attempts have been made to quantify the extent of harm.[3] The next section provides a critical evaluation of these estimates.

Recording Industry Association of America

Under the auspices of the Recording Industry Association of America, Greenspan (1983) prepared an estimate of "the impact and implications of home audio taping on unit sales of discs and prerecorded tapes...." Greenspan (pp. 6-7) argues that

> From the available data, it appears that roughly half of the taping from borrowed records or tapes would have generated record or tape purchases had home audio taping not been possible. The data indicate that approximately 42 percent of the taping from owned records (mainly for car or office copies) would have resulted in purchases of additional records and prerecorded tapes. And, two-fifths of all the off-the-air taping probably would have generated record or tape purchases. Overall, this suggests that more than two-fifths of home taping was in lieu of the purchase of prerecorded records or tapes last year. This represents lost sales of approximately 32 percent of the total volume of record sales in 1982. This percentage of sales displaced by home taping is the equivalent in 1982 to lost record sales of more than $1 billion. In addition, sales are being displaced by taping over previously-recorded music or speech. As home inventories of recorded tapes grow, this will become an increasing source

[3] A number of estimates of the harm resulting from the copying of computer software are reported in Tyler (1986). None of these estimates appears to be based on a systematic analysis, however. For a report of a set of estimates of harm from computer software piracy in Great Britain see "Pulling computer-copycats' claws," *The Economist*, September 8, 1984, p. 72. The methodology employed to obtain these estimates, which are substantially lower than those reported in the Tyler paper, is not presented. Another estimate of the amount of copying that is substantially smaller than those reported in Tyler appears in "$800 million toll," 19 *Computerworld*, January 21, 1985, p. 1, p. 4. Future Computing estimates that U.S. software vendors lost $1.3 billion in revenues between 1981 and 1984 as a result of unauthorized copying.

> of retail sales displacement. It is difficult to estimate the size of this displacement owing to the multiple use of tapes, but it could easily have amounted to more than a couple of hundred million dollars in 1982. Finally, we estimate that this sales displacement depressed prices on all record sales by at least 5 percent ($160 million) below what they otherwise would have been. Hence, we estimate the overall retail dollar losses from home taping last year were more than $1.4 billion.

The estimate of $1 billion dollars of lost revenues was derived as follows. Using survey data, Greenspan estimated that 42.6 percent of taping off the air or from owned or borrowed records or tapes displaced retail purchases. This amounted to about 98 million hours of displaced retail purchases, based on an estimate of the total amount of music hours recorded on blank tape. Since there were approximately 305 million hours of music recordings sold in 1982, Greenspan estimates that retail sales were approximately 32 percent (98/305) lower than they would have been without taping. Since retail purchases were about $3.2 billion dollars in 1982, Greenspan estimates a loss in sales of about $1 billion.

The conclusion that retail prices were reduced by "at least 5 percent" was reached as follows. Greenspan notes that

> the average price of pre-recorded tapes tracked the implicit price index for all consumer expenditures fairly closely through 1978 but, beginning in 1979, tape prices lagged. By 1982 the divergence had cumulated to 22 percent. Data collected for the years 1974 through 1979 indicate that gross profit margins were stable between 1974 through 1978, but dropped sharply in 1979 suggesting that the failure of tape prices to match consumer price increases in 1979 reflected competitive pressures such as home taping.... We have used "at least 5 percent" to provide a conservative estimate of how much of the retail dollar loss was attributable to depressed prices, since profit margin data for the past three years are fragmentary.[4]

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[4]Attachment to letter from Gary H. Sherman to Sen. Charles McC. Mathias, Jr., December 12, 1983, p. 4.

Motion Picture Association of America

Under the auspices of the Motion Picture Association of America, Cronin et al. (1983, pp. 84-85) estimated the magnitude of the royalties lost to copyright owners as a result of sales displaced by tape copying and off-air taping. They derive their estimates as follows: First, they estimate a model of the demand for prerecorded videocassettes, the demand for blank videocassettes, and the demand for rented prerecorded videocassettes. Among the explanatory variables in each equation is the price of the good, and those of each of the other goods. Thus, for example, the price of blank videocassettes appears as an argument in the demand functions for prerecorded and rented videocassettes.

Next, they determine a price for blank videocassettes "which greatly reduces blank videocassette sales." They then use this price in their "model of the demand for prerecorded videocassettes to estimate the number of additional prerecorded videocassettes sold. Sales of prerecorded videocassettes approximately double. Thus, [they] assume sales of prerecorded videocassettes to those engaged in copying would double if the market for blank videocassettes largely disappears."

Using this result, they estimate that "the number of displaced sales for 1982 would be about 1,103,000 units and for 1990 would be almost 11,240,000 units. Using an assumed royalty of $10 on each prerecorded videocassette, [they] obtain estimates (expressed in 1982 dollars) of lost royalties of $11,030,000 and $112,400,000 in 1982 and 1990, respectively."

The same calculation is repeated to estimate the effect of off-air taping on the sale of prerecorded videocassettes. Their approach also predicts an approximate doubling of sales of prerecorded cassettes to those engaged in recording from television. Using this result, they estimate "royalties lost in 1982 of $26,860,000 and $19,300,000 for commercial and pay television, respectively; the comparable 1990 estimates are $273,700,000 and $196,700,000."

International Federation of Phonogram and Videogram Producers

Davies (1983, pp. 60-61) reports that a survey conducted in 1979

> showed that an equivalent of 280 million LPs had been copied, which represented an approximate retail value of [$2,490 million]. During that year, only 74.5 million LPs and 25.2 million cassettes had been sold for a value of [$807 million]. The British Phonographic Industry has put forth a reasonable and conservative estimate based upon consistent evidence derived from the surveys that 25 percent of these private recording sessions replace the purchase of the LP, tape or single in question. The value of these copies, if sales had been made through normal retail outlets, would have been approximately [$622 million] in 1979, which is the equivalent of 70 percent of the value of retail sales during that year.[5]

Davies (1983, p. 69) also reports the results of a study of the losses that result from the private copying of videograms in the United Kingdom. They indicate that a "tentative estimate of the extent of the losses to the video industry...[was that] the shortfall in revenue could be at least [$24 million] at the retail level and that the net loss to right owners could be in the region of [$9 million]."[6] No details of the methodology employed to obtain this estimate are provided.

AIM Report

A number of estimates of the effect of home taping, and the methodologies employed to obtain them, are reported in Keon (1982, pp. 17-18). Keon first reports the results of a study of the British market performed for the British Phonographic Industry by the Chartered Accountant firm of Anna, Impey, Morrish and Partners (AIM). The study was based on surveys of taping by the British Market Research Bureau Limited (BRMB) in 1973, 1975, and 1977. "Rough estimates of the length of time of the music taped in-home were correlated with the average

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[5]The survey in question is *Tape Recording - Report on a Quantitative Survey*, prepared by the British Market Research Bureau Limited on behalf of the BPI (British Phonographic Industry) and the MCPS (Mechanical Copyright Protection Society), January 1980.

[6]The study was EIU, *The UK Market for Home Video Products*, 1982.

length of pre-recorded material to calculate the LP equivalent hours of home recorded music." These estimates were employed in three ways to estimate lost sales.

First, the answer to a survey question on whether the respondent "would have bought the last music recorded if they had not taped it" was combined with the estimate of equivalent hours of home recorded music to produce estimates of lost unit sales. This was then multiplied by the average LP price to obtain an estimate of lost sales. For 1977, the estimate was between 63 and 98 million British pounds sterling.

Second, data on blank tape sales and estimates of the proportion used for home taping were combined to obtain an estimate of the number of LPs recorded at home. The survey evidence on whether the taper would otherwise have purchased the LP was then used to produce an estimate of lost unit sales. This was then multiplied by the average LP price to obtain an estimate of lost sales of from 90 to 139.5 million British pounds.

The third estimate was obtained by comparing actual sales to those based on an extrapolation of sales using data from 1972 to 1974. This method produced an estimate of lost sales of 85 million British pounds.

Roper Survey

Keon (1982, pp. 22-23) also reports the results of a survey conducted by the Roper Organization for the National Music Publishers Association and the Recording Industry Association of America on the taping of music in the United States. People who taped at home, whether from their own collections, from borrowed records or tapes, or from the radio, were asked how many records or tapes they saved buying as a result. "According to the respondents' figures, 90 percent of everything taped from sources other than their own collection would have been purchased if not taped in-home." This translates into lost sales of 268 million albums and 213 million singles. However, this was regarded as an overestimate by Roper "which preferred to accept a potential sales loss figure of 14 percent."

AN EVALUATION OF THE ESTIMATES

For a number of the estimates reported above, not enough detail is provided about the methodologies employed to permit a critical assessment. However, the others are subject to a number of shortcomings, most of which are shared by the various studies. These are discussed in this section.[7]

The basic methodological shortcoming of the previous studies of the extent of harm is that the studies do not clearly describe either the behavior of consumers or producers in the absence of copying.[8] Although some surveys ask consumers whether they would have purchased an original if they could not copy, the answer to this question is of limited usefulness if consumers do not know what the price of originals would have been if copying were not possible. And, by the same token, the process of translating lost unit sales into lost revenues is not possible without knowing the price that would have been charged for originals if there were no copying.

In general, the profit maximizing price for originals will be affected by whether or not consumers are able to copy.[9] In some situations, the producer will raise the price it charges for originals, to take advantage of the fact that originals will be shared by several users. In others, the producer will reduce the price of originals, to make their purchase more attractive and to discourage sharing. Only in exceptional circumstances will the price of originals be unaffected.[10]

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[7]It should be noted that most, if not all, of the estimates of harm reported by Tyler (1986) are based on estimates of the extent of copying of computer software for which there is no support. However, even better data on the amount of copying do not guarantee that resulting estimates of harm will be accurate.

[8]Many of the estimates also contain additional problems. For example, one critical parameter in Cronin et al. (1983) is not significantly different from zero.

[9]See Besen (1984, 1986) for an analysis.

[10]The Besen model provides only one way in which the price may be affected. For a different approach to the same problem see Novos and Waldman (1984).

Since the price of originals will generally be affected by the existence of copying, the meaning of the answer that consumers give to the question of whether they would have purchased an original if they could not copy is ambiguous. Do they interpret the question to ask whether they would have purchased an original at the prevailing price of originals, or at the price that would exist if there were no copying? And, if the latter, how do they determine what the price would be?

Similarly, even if the number of unit sales lost because of copying can be estimated correctly, translating that figure into lost revenues is not straightforward. All of the estimates reported above employ the prevailing price of originals in making this calculation. However, if producers have raised prices to take into account the existence of copying, this procedure will overestimate lost revenues.[11] If producers have lowered prices to discourage copying, lost revenues will be understated.[12]

Only the Greenspan study for the Recording Industry Association of America even addresses the question of the effect of copying on the price of originals. It argues, on the basis of the fact that, in recent years, record prices have lagged behind consumer prices in general, that taping has forced producers to set prices below what they otherwise would have been. If this is correct, the conclusion that the estimate of lost revenues presented is understated would also be true. However, a much more rigorous analysis of the determinants of record prices would be needed before such a conclusion could be accepted.[13]

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[11]Keon (1982) also points out that all of the estimates that he reports are based on retail rather than wholesale prices.

[12]Lost revenues are not, of course, the same as lost profits. Even if revenues decline because of lower unit sales, profits will fall by a smaller amount, since the costs of producing originals have been reduced.

[13]Keon (1982) makes a similar criticism of some of the estimates made by AIM.

HOW TO ESTIMATE HARM

To estimate the effect of copying, it is necessary to determine what would have been the situation if copying had not occurred. The criticism raised above to the various estimates of harm that have been made is that their explicit or, more usually, implicit counterfactual is not rigorously derived. That is, they do not proceed from a model of the market that provides an estimate of what would have happened in the absence of copying.

The model developed by Besen (1984, 1986) does permit the determination of such a counterfactual.[14] The technique is to "calibrate" the model, using data on the number of copies made per original, the cost of copying, the cost of producing originals, the number of originals sold, and the price being charged for originals in the absence of copying. That is, given the values of these variables, one can estimate the demand for originals which, in turn, can be employed to analyze the effect of copying.

The intercept of the demand curve can be determined using data on the price of originals, the costs of producing originals and copies, and the number of copies per original.[15] The intercept, together with the cost of originals, can then be employed to determine the price of originals that would have prevailed if there were no copying. With data on the number of originals sold, the estimated intercept of the demand curve, and the number of copies per original, the slope of the demand curve for originals can be calculated. Together with information on the costs of producing originals, the market equilibrium that would have existed in the absence of copying can be estimated.

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[14]Other models, which would lead to other counterfactuals, are, of course, possible. The point is that some model of the process is necessary if harm is to be estimated. Although Cronin et al. (1983) do have a model of the demand side of the market, they makes no attempt to determine the effect of rental and off-air taping on the price of prerecorded cassettes, implicitly treating it as exogenous.

[15]A basic assumption that permits this and other calculations is that producers attempt to maximize profits. For details of the model the reader is referred to Besen (1984, 1986).

From this information, the effect of copying on the welfare of consumers and on producer profits can be calculated. That is, one can compare the actual equilibrium quantity and price of originals to the price and quantity in a simulated equilibrium without copying. By comparing consumer welfare and producer profits in the two situations, the effect of copying can be estimated.

The approach proposed here uses much of the same data as employed in making the various estimates of harm discussed above. The only additional information needed is the costs of producing and distributing originals and copies, respectively. However, it does not require consumers to indicate whether they would have purchased originals if they had not copied. Instead, the answer to that question is inferred from other data. The approach differs significantly from others by employing an explicit model to deduce the harm that results from copying.[16]

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[16]The approach can also be used to analyze the effect of video rentals, as well as other means of sharing originals.

VI. PUBLIC POLICIES TOWARD INTELLECTUAL PROPERTY

It should be clear from previous discussions that there is no presumption that the market for intellectual property functions efficiently. There are three basic reasons for this. First, nonpayers often cannot be excluded from using such property, so that producer revenues will fail to reflect the value placed on their output by all users. Even where producers employ alternative methods of support, e.g., advertising revenues or the bundling of the intellectual property with other products, there is no presumption that the amount of intellectual property provided will be efficient.

Second, even where exclusion is feasible, producers usually cannot establish the differentiated prices that may be required for efficient production. And, in any event, some consumers may be prevented from using a product even where there is no additional cost to serving them.

Finally, the market cannot be expected to provide the efficient variety of such products. Too little variety will result if producers find it more profitable to "duplicate" the products of other firms, rather than provide differentiated products. Too much variety will result where it is profitable to provide differentiated products but consumers place little value on the additional variety made available.

For these reasons, various types of government intervention have been proposed or employed to improve on the workings of the market. This section explores the advantages and disadvantages of a number of these policies. The basic conclusion is that, although private markets for intellectual property cannot be expected to function efficiently, none of the alternatives is without its flaws.

DEFINING PROPERTY RIGHTS

The simplest type of government policy for dealing with intellectual property is to assign rights to the producers of such property and to rely on private enforcement of those rights through civil litigation. That is, property rights holders would be required to

employ the courts to either enjoin unauthorized uses or to collect monetary damages when infringements cannot be enjoined.

Under such a system, rights holders would be expected to employ various forms of "self help," including pricing, marketing, and technological protection strategies, but the legal system would provide a complementary form of protection. Moreover, where the cost of enforcement of property rights is great, i.e., where it is difficult to exclude nonpayers, property owners can be expected to adopt mechanisms for collecting revenues other than from direct sales to users. Thus, advertiser support and the bundling of intellectual property with other goods are often employed by vendors of such property, even where their property is protected by copyright.

In addition, under this arrangement it is not uncommon for rights holders to combine their efforts in enforcing their rights and collecting for uses. Entities such as ASCAP, BMI, and the Copyright Clearance Center[1] owe their existence to the fact that there are economies of scale in the enforcement of rights, so that the costs of enforcing the rights of a number of different holders through a single organization are smaller than the combined costs of enforcing those rights separately.

Under a system of defining property rights that must be privately enforced, it still must be determined what rights should be assigned and for what period. That is, even if this approach were adopted as the entire "solution" to the intellectual property problem, unless all rights are assigned to the creator in perpetuity--assuming that is feasible--it is necessary to determine precisely what rights are to be protected and for what period.

For example, should patents extend for 17 years, or for some longer, or shorter, period? Should authors have the right to control the preparation of translations of their work? Should limited nonprofit copying for scholarly purposes be treated as fair use and thus not as an infringement? Should the algorithms contained in computer programs be protected "expression" or unprotected "ideas"? Is off-air taping of advertiser-supported programs for purposes of time shifting an infringement?

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[1]See Spilhaus (1978) for a description.

Presumably the answers to all of these questions, if the objective is to promote economic efficiency, depend on a balancing of the additional rewards to creators made possible by the expansion of their rights, and the amount of additional creative effort forthcoming, against the losses to consumers from more restricted uses of intellectual property already produced.

As we have argued above, striking this balance correctly in any particular instance is a formidable undertaking. Some have argued that in most, if not all, cases, the optimum should be struck with few, if any, rights afforded to creators.[2] Others have argued for extensive rights for creators. But however the balance is struck, this approach has the virtue, once rights have been defined, of placing the entire burden of their enforcement on the owners of those rights. If the harm done as a result of infringements is large, this creates a large incentive for their enforcement. Where infringing uses cause little harm, they will be ignored. Moreover, this approach maximizes the incentives of creators to find private mechanisms for protecting the rights that they have.

COMPENSATORY LEVIES UNDER COPYRIGHT LAW AND GOVERNMENT COLLECTION MECHANISMS

To overcome the difficulties in collecting from all users of a product, copyright holders have sometimes attempted to have the government collect revenues from users according to some formula, and to distribute the proceeds among rights holders in a similar manner, or to permit the rights holders themselves to establish collective compensation mechanisms. A common procedure is for a license to be granted to draw from a large collection of works, with the required payment based on the revenues of users or on the sale of some related good.

There are two principal justifications for the adoption of collective compensation mechanisms. First, copyright owners are often unable to collect directly from infringers, so that without these

[2]See Plant (1934a, 1934b) and Breyer (1970).

mechanisms they would receive no payments when their rights are violated. By permitting charges to be levied on recording equipment or media, infringing users can be made to compensate copyright holders. In short, these types of mechanisms sometimes exist because property rights cannot be enforced through the legal system. Private copying is an important example of situations in which enforcement is difficult or impossible.

The second reason for adopting these mechanisms is that the decentralized nature of the infringements means that the harm from any given infringement is small. That is, any single infringement does not impose large enough costs on any single rights holder to make it worthwhile for him to attempt to enjoin, or collect damages from, the infringer. By combining the interests of different rights holders, economies in collective enforcement of rights can be exploited.[3]

In a number of countries, legislation has been adopted that provides for compensatory levies under copyright law.[4] Under such arrangements, owners of copyrights are given the right to demand from the manufacturers of recording equipment or recording media compensation for the reproductions made of their works. Thus, for example, in the Federal Republic of Germany, authors of audio and visual works can demand remuneration from the manufacturers of recording equipment because the equipment will be used to make unauthorized reproductions of

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[3]Frequently, of course, the two factors appear in combination. Where, as in private copying, infringements are decentralized, rights are difficult to enforce and the losses from any single infringement are small. Note that not all such arrangements are the result of attempts by producers to minimize transactions costs. The compulsory license for the retransmission of broadcast signals by cable television systems was strongly opposed by program producers. The cable industry argued, however, that the costs of negotiating permission to retransmit these signals would be prohibitive, and this argument was apparently accepted by the Congress. An additional factor was that the level of the payment was set by legislation, and it was argued by program suppliers that the legislated royalty payment was substantially lower than the price that would prevail in the private market.

[4]See *Unauthorized Reproduction for Private Purposes Sound and Audiovisual Recordings, Broadcasts and the Printed Word*, prepared by the Secretariats of UNESCO and WIPO for a Group of Experts on Unauthorized Private Copying of Recordings, Broadcasts and Printed Matter, Geneva, June 4-8, 1984.

their works. This right must be enforced through collecting societies and each copyright owner must be permitted to share in the resulting revenues. The total payment to all rights holders is limited to 5 percent of the proceeds of the manufacturer.[5] In Austria, authors of audiovisual works have similar rights as against manufacturers of blank tapes, with the amount of the royalty being established by law.

In Hungary, a somewhat different mechanism exists. Authors, performers, and producers of sound recordings share in the proceeds of a levy on the distribution of blank media. Significantly, the amount of the levy is established by the Bureau for the Protection of Authors' Rights and approved by the Ministry of Culture. The manner in which the proceeds are to be divided among authors, performers, and producers is prescribed by law.

In the United States, a compulsory license mechanism has been established to permit cable television systems to retransmit distant broadcast signals without having to negotiate either with the broadcast stations whose signals they carry or with the copyright owners of their programs. The license fee was originally established by law, but the Copyright Royalty Tribunal is empowered to change the fee under certain specified circumstances. For example, after the Federal Communications Commission effectively deregulated cable television, the level of the fee was substantially increased.

The Tribunal is also responsible for determining the distribution of the royalty fees among competing claimants, unless copyright owners are able to agree on the distribution. Until now, the Tribunal has been forced to allocate the fees among major groups--syndicated program producers, sports interests, and broadcasters--with the distribution within these groups being successfully accomplished by the parties themselves.

The variety of these mechanisms makes clear that there exists a large number of ways in which to determine the royalty fee. The law may give an organization of rights holders the authority to negotiate for a fee on behalf of its members, unconstrained by the government. It may

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[5]For a description of the German system and the developments leading to its adoption see Reinbothe (1981).

establish the magnitude of the royalty itself. It may permit the fee to be negotiated subject to a ceiling contained in the law. It may permit negotiated fees subject to government approval.

Where the fee is determined by direct negotiation between users and rights societies unconstrained by government, the obvious problem is that, intead of competing with one another for the patronage of users, copyright owners have a collective interest in, and a mechanism for, setting prices anticompetitively.[6] Indeed, if the collecting society is also responsible for distributing the proceeds of the royalty fee among its members, and if the costs of transactions among rights holders are not too great, all producers can be made better off by agreeing to the monopoly price to maximize joint profits.[7]

If the royalty fee is set at the monopoly level, there will, of course, be less sold than if prices were determined in a competitive market. Recall, however, that the purpose of establishing a royalty fee mechanism is to deal with the undersupply of the good that results from the inability of producers to collect from all users. Therefore, even if royalty fees are set at monopoly levels, the outcome may be less *inefficient* than if there were no mechanism for collecting fees. What this implies is that royalty fee arrangements in which fees are unregulated should be reserved for those cases in which it is likely that private markets functions very inefficiently.

At the same time, government establishment of the fees is not an especially attractive alternative. The government will often not possess the information needed to establish the appropriate fee and will

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[6]For a discussion of the various attempts to prevent anticompetitive behavior by the American Society of Composers, Authors, and Publishers (ASCAP) see Comment (1981).

[7]Note that it is not possible to resolve this problem by providing for separate negotiations with each producer. Unless a collecting society, or similar organization, can negotiate for all producers simultaneously, any single producer can improve his situation by "holding out," refusing to grant a license to use his products unless he obtains a large share of the benefits from the agreement. But all producers have the same incentive, so that no agreement may result. The economies that come from collective negotiation thus result not only from the savings of the cost of many transactions, but also from the avoidance of this "holdout" problem.

often be subject to political pressures to set the fee for the benefit of one party or another. In this connection, the American experience with the establishment of compulsory license fees for cable television by the Congress and the Copyright Royalty Tribunal is not especially comforting.[8]

It should also be noted that, whether royalty fees are set by the government or by negotiations involving collective rights organizations, certain types of inefficiencies are almost certain to be introduced. For example, if royalties are established on blank videocassettes to compensate television program producers for infringing uses, the royalties will also be paid by those who use videocassettes for noninfringing uses, for example, the taping of programs that are not copyrighted, or family or social functions. The result may be to discourage some noninfringing uses, which would be inefficient.[9]

DIRECT GOVERNMENT SUPPORT

Given the inefficiencies that are associated with the production and distribution of intellectual property through private markets, it has been argued that, for at least some types of intellectual property, a superior system would be one in which production is supported directly by government. This view is especially held by those who believe that the inefficiencies lead to substantial undersupply of invention and creative effort.[10]

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[8]Where the fee is set by private negotiation subject to a governmentally imposed maximum, or where the privately negotiated fee must be approved by the government, unless the ceiling set by the government exceeds the monopoly price, it is likely to become the *de facto* price. Thus, those systems suffer from the same shortcomings as does an arrangement under which the government sets the fee directly.

[9]This is not to say that the fact that taxing these uses is inefficient is dispositive. It may still be desirable to impose a royalty even where some efficient uses are discouraged. But these inefficiencies must be taken into account in determining whether to impose the royalties in the first place, just as the inefficiencies from monopoly pricing must be considered in judging the desirability of rate setting involving collecting societies.

[10]See, e.g., Arrow (1962). The view that the market will undersupply information is strongly criticized in Demsetz (1969) who argues (p. 12) that "the practice of creating property rights in information and allowing its sale is not clearly inefficient in comparision with [its real alternatives]."

Although this arrangement will lead to efficient use of whatever is produced, there is no guarantee that what will be produced will be efficient. After all, the government must determine what will be produced, and it will have few, if any, market signals to guide its efforts. Moreover, the interests of government officials cannot necessarily be presumed to be congruent with the promotion of economic efficiency. That is, those projects that are most able to obtain political support are not necessarily those that make the greatest contribution to economic efficiency. Nevertheless, there may be certain types of creativity that are so poorly supplied by the market that government intervention of this sort is required. Since undersupply is likely to be most prevalent in the case of basic research, where the appropriation of benefits by creators is most difficult, it may be desirable to confine government support to this area.

In addition, basic research is an area in which it is likely that the benefits of widespread dissemination are especially great. For this reason, it may be desirable to attempt to promote the creation of new knowledge in these areas by a system that does not rely on limiting use to provide rewards to creators.

Nonetheless, one should be leery about using government support as "the" solution to the intellectual property problem. Government is itself likely to be quite inefficient in carrying out this task so that the other approaches discussed above, private provision and collective royalty arrangements, will have to play a role in any well-designed system. The problem, and it is an enormously difficult one, is to determine the appropriate role for each.

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